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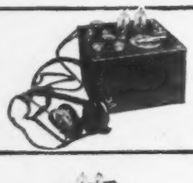	**Radiola III** With two WD-11 Radiotrons* and head telephones.	$35	Up to 1500 miles with headphones. Local stations on Loudspeaker.	Outdoor or indoor antenna.	Improved selectivity. Minimum radiation.
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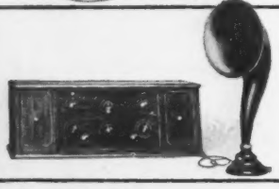	**Radiola Regenoflex** with four WD-11 Radiotrons,* and Radiola Loudspeaker.	$206	Loudspeaker operation up to 2000 miles under favorable conditions.	Outdoor or indoor antenna.	Extraordinary selectivity. Nonradiating.
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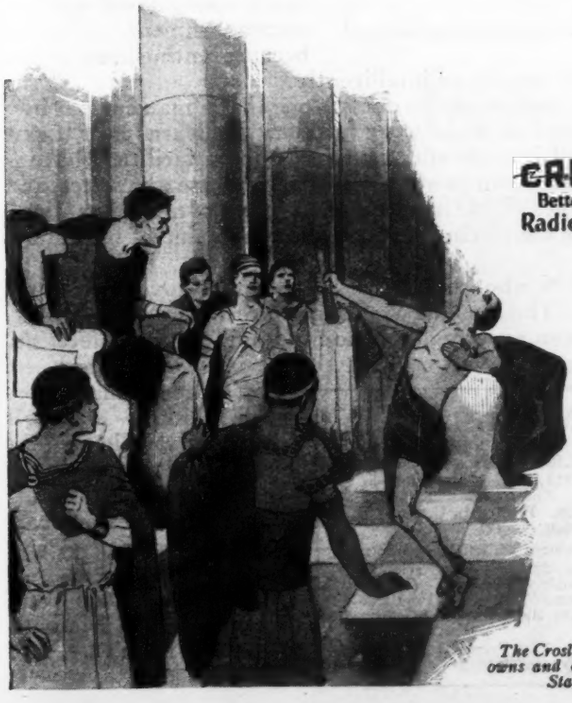

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Popular Science Monthly

Most Wonderfully Illustrated Magazine in the World

MAY, 1924; Vol. 104, No. 5
25 cents a Copy; $2.50 a Year

Published in New York City at
225 West Thirty-ninth Street

A YOUNG friend of mine stopped in front of a hardware store the other day. "Some of the doors at home stick badly and that's a fine excuse to get myself a good plane," he said. "Of course, I could get a carpenter to come around and fix the doors for a couple of dollars, but I'm going to get the plane."

My young friend knows the thrill of tools. He knows the creative joy that comes in doing things, and doing them well. For him a fine tool is a delight—a means of recreation from his workaday world. And so he constantly seeks for an excuse to add to the contents of his toolchest.

* *

FOR most men, whether they are mechanics or not, tools have a real and vital fascination. And is it any wonder? Every time you pick up a saw, a hammer, or a chisel, you have something that symbolizes most vividly the upward climb of the ages. It is a volume of thrilling history and romance. It is a monument to the persistent mechanical and scientific efforts of your ancestors, historic and prehistoric, through countless centuries.

* *

TAKE the saw, for instance. The handsaw in your household toolkit, the milling cutters of the machinist, the 108-inch inserted tooth circular saws that operate at a rim speed of 130 miles an hour—these are miracles of inventive genius. Their lineage is linked with the mechanic arts of all past eras.

The Greeks had saws. Hippocrates, four centuries before Christ, is said to have invented a drum saw for trepanning skulls. There were iron saws in Biblical times—and sometimes they did shocking service in sawing asunder prisoners of war. The Egyptians cast saws in bronze and are credited with having used inserted teeth of gems for cutting hard rock. Back in the Age of Bronze there were notched saws of bronze and, yet more remote, in the mists of the Stone Age, were saws patiently chipped from flint.

* *

THE story of modern tools and their facilitation of the work of the world is told each month in POPULAR SCIENCE MONTHLY. Look through the pages of this issue and read the month's history of tools and tool users. Picture the tools and machinery necessary for an undertaking as vast as the project to harness the tides of the Bay of Fundy, as described on page 29! You can only realize what an amazing mechanism your watch is (see "Does Your Watch Know You?" page 38) when you stop to think that in making it there were necessary 3733 distinct operations with tools!

* *

IN THESE columns I have stressed frequently the need for enthusiasm. Without enthusiasm little can be accomplished in life. But nowadays men often expend much enthusiasm without accomplishment. That is because enthusiasm is not always employed intelligently.

An enthusiasm for tools is one that a man can put into harness and make work for him. He learns how to put himself into his efforts and to employ facilities that increase his own powers. And the bookcase, the settee, and the other simple furniture in the home of my young friend offer a convincing argument for the value of his hobby.

* *

MEN who know tools best seem to love them best. The late Joe V. Romig once wrote: "My workshop comes second only to my family in my affections. It is a dream shop—a boy's dream made possible through a man's work and development."

How the true mechanic makes the most of his tools is the message carried this month — and every month — in our Home Workshop and Better Shop Methods Departments.—THE EDITOR.

Laboratory Tests to Aid You in the Selection of Radio, Tools and Other Equipment

TO MEET the need of the ever-increasing number of people who are interested in things mechanical and electrical, POPULAR SCIENCE MONTHLY has established an organization for testing radio sets and apparatus, tools of all kinds and equipment for the automobile.

The testing will be conducted by THE POPULAR SCIENCE INSTITUTE OF STANDARDS under the direction of Prof. Collins P. Bliss, of New York University.

Full details of this important new service will be announced in the June issue.

POPULAR SCIENCE MONTHLY

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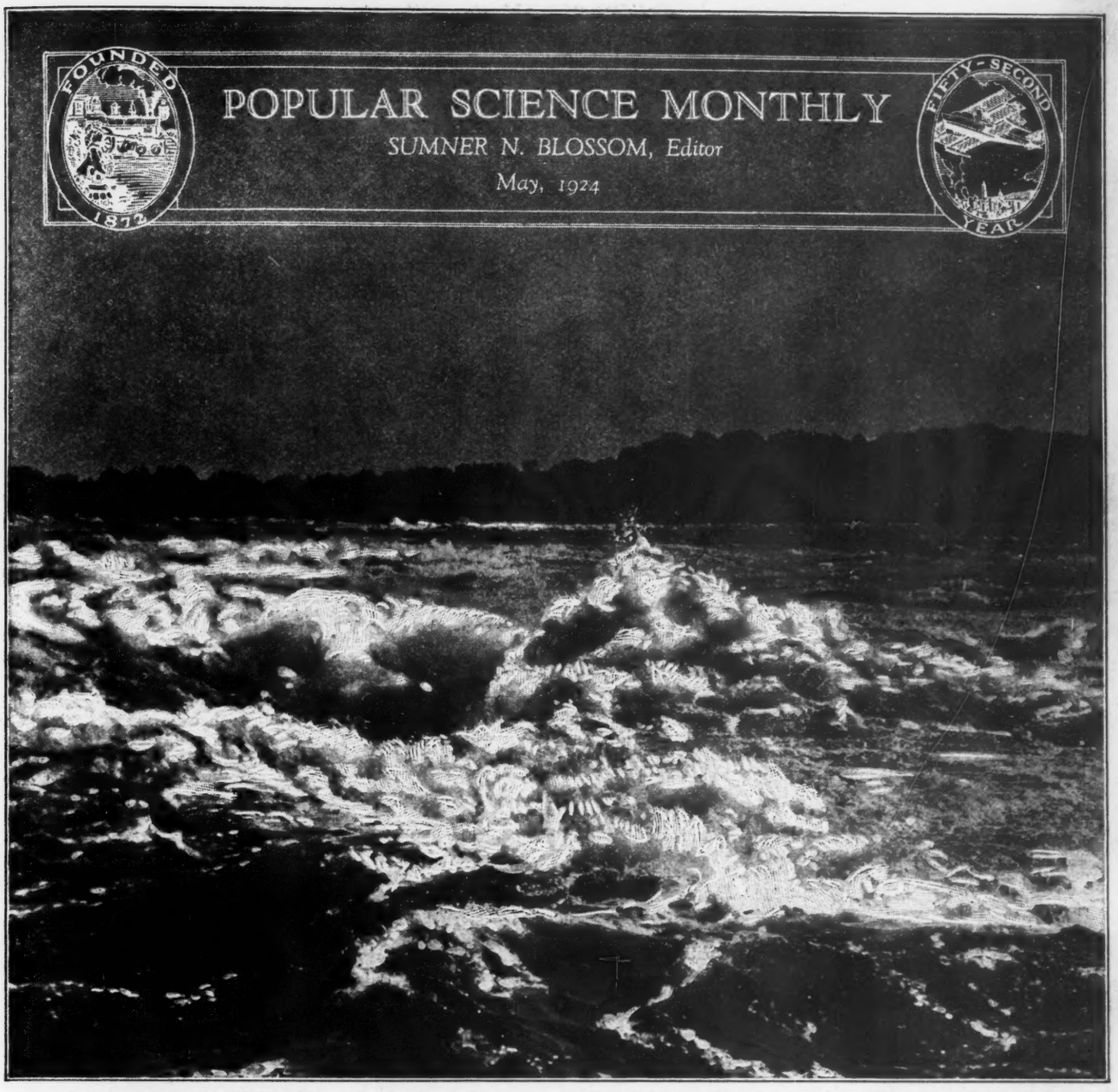
POPULAR SCIENCE MONTHLY
SUMNER N. BLOSSOM, Editor
May, 1924



Foaming rapids of the Niagara River. In the new project to put the tides of the Bay of Fundy to work, a tidal stream equal to this in volume—222,000 cubic feet a second—will be poured continuously through a power house to generate 400,000 electric horsepower

Niagara's Power from the Tides

By René Bache

THE Federal Power Commission at Washington, D. C., now has under consideration a new project for harnessing the tides of the Bay of Fundy, at the northeast corner of the United States. It is said to be the first really practical plan for a large-scale tide-power development in this country.

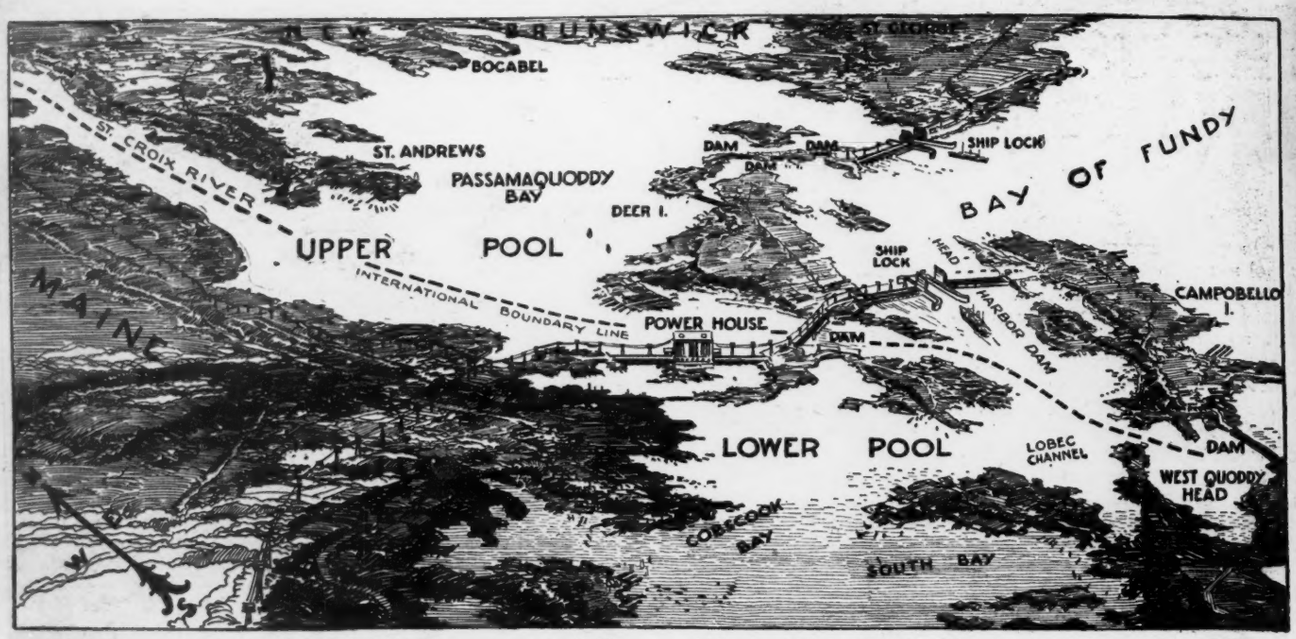
We are harnessing our rivers, and, with the help of wonderful new machinery, are converting the energy of their flow into electricity for industrial uses, for illumination, and even for operating railroads. The eventual possibilities of such hydro-electric developments are gigantic. Nevertheless, they have an ultimate limit, which engineers already are able to estimate with a fair degree of definiteness. The power the tides could furnish, on the other hand, is limited only by the vastness of the seven seas and by the eternal journey of the moon around the earth!

Control and use of that power is the next great epoch-making achievement that mankind may expect. Discovery of a means whereby this can be accomplished will elevate civilization to a new plane. It will mean that all of our factories can be run by the tides; that our cities can be lighted and our houses heated by the unfailing moon!

The moon? Exactly so. For it is the moon's attraction that makes the tides. If we can make the tides work for us, we shall in effect be harnessing the lunar orb to supply the demand for power that now is draining the world's limited fuel resources.

As a matter of fact, the thing was accomplished successfully long ago. Formerly along the New England coast there were tide mills operated in places wherever an inlet could be dammed conveniently, with a pond to hold the water that flowed in on the rise of the tide. Power was derived from the flow of the water into the pond and out again, driving a large paddle-wheel. It was continuous power (used for small sawmills and flour mills), thanks to a most ingenious arrangement by which the current that drove the wheel was made to run in the same direction all the time, whether the tide was coming in or going out.

UPON a principle similar in effect, is based the new project for putting the tides of the Bay of Fundy to work. The plans include the building of four dams, with a total length of five miles, across the outlet of Passamaquoddy Bay and Head Harbor, thereby creating two pools, upper and lower, with a power



A bird's-eye map, showing the proposed tidal power project in the Bay of Fundy. By a series of dams, two pools, upper and lower, would be created, with a power house between them. The rising tide would be permitted to pour through a system of gates, driving the turbines at the power plant, and filling the upper pool. During ebbtide the lower pool would be permitted to empty itself into the sea, while a stream equal in volume to a great river would pour out of the upper pool through the power house, continuing the drive of the turbines. The plan simply is an elaboration of the primitive New England tide mill illustrated below. It would supply electricity to Maine and eastern Canada

house between, as shown in the illustration above.

It is proposed to install a system of gates that will permit the floodtide to pour into the upper pool, and allow the lower pool to empty itself at ebbtide. By this arrangement a stream equal in volume to the Niagara River will be poured continuously through the power house, driving turbines that are expected to generate enough electricity to supply a large part of Maine and eastern Canada.

The tides in the Bay of Fundy rise and fall through a range of from 35 to 45 feet—one of the greatest tidal ranges in the world. At the power house an "operating head"—never less than 16 feet and running as high as 27 feet—will be maintained. From 400,000 to 500,000 continuous electrical horsepower will be developed.

THE upper pool, about 16 miles long by 10 miles wide, will be separated from the lower by a dam between the Maine shore and Deer Island—the power house to be close by this dam—and by two dams connecting Deer Island with the New Brunswick mainland and Campobello Island, respectively. A fourth dam, to impound the lower pool, will bridge the gap between Campobello Island and West Quoddy Head.

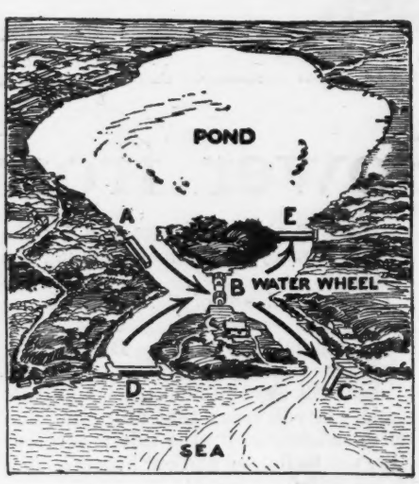
The lower pool will be somewhat less in area than the upper one. Locks are to be provided at the dams connecting Deer Island with Campobello Island and the mainland of New Brunswick, permitting ships to pass from one pool to the other.

Tides in the open ocean rise and fall with a maximum range of three feet; but the waters of the sea, rushing at flood into an estuary such as the Bay of Fundy, are literally piled up, so that in that great bay the difference in level between the high and the low tide sometimes is as much as 45 feet.

The idea back of the tremendous superpower project is that the flood at each rising tide shall be allowed to pour through opened gates, filling the upper pool. During the rise it will drive the turbines at the power dam. During the ebb the lower pool will be permitted to empty itself into the ocean, while a stream equal in volume to a large river pours out of the upper pool through the power house, driving the turbines.

The turbines will operate huge dynamos. And, since the supply of power will be continuous, there will be no pause by day or night in the production of electricity, which will be distributed by wires over a vast area for industrial and domestic uses.

All this useful energy will be captured indirectly from the moon. Oddly enough, few people realize how big the moon is. Its diameter is a little more than one fourth that of the earth—2163 miles, to be exact—and its attraction is so great that it causes two great waves in the ocean, on opposite sides of the earth, to travel around the globe once in 24 hours. These waves make the tides. The sun's attraction is concerned incidentally, for it causes extra high tides when in a position to help the pull of the moon.



How the simple New England tide mill operates. A small pond serving as a reservoir is connected with the sea by two channels that cross each other. A water-wheel is placed at the intersection of the channels. During the outflow of the tide, the gates at *A* and *C* open, as above, supplying current to the water-wheel *B*. At the same time the gates at *D* and *E* automatically close. During the influx the gates at *A* and *C* close, and *D* and *E* open, producing a flow through the wheel in the same direction as before. Thus the power is continuous during both phases of the tides

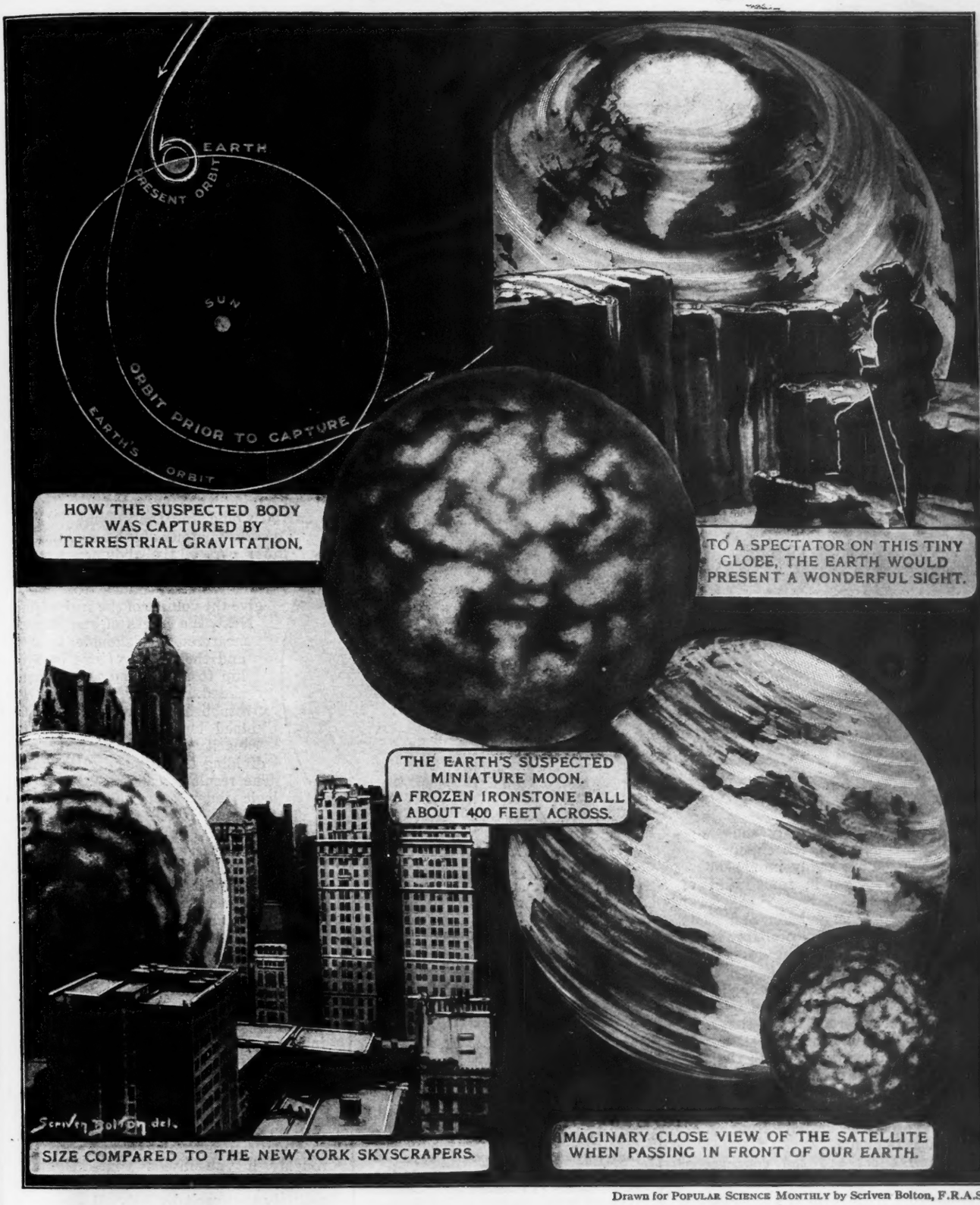
THE tides represent unlimited power going to waste. But tide-power developments are practicable only where the tide enters an estuary and, with a piling up of the water, rushes up a channel. This phenomenon, conspicuously illustrated in the Bay of Fundy, is called a "tidal bore."

Developments for the utilization of tidal power are in practice limited to localities where natural facilities are favorable for creating tidal basins, where portions of the flow can be impounded and controlled, and where conditions are suitable for the erection of power plants similar in character to hydroelectric stations.

All this, of course, applies to large-scale developments. Small tide mills were in use in England as early as the eleventh century, and also in Brittany. In a simple form, such an installation can be made by placing the power plant between two channels connecting the sea with a reservoir basin, as in the New England power mill. One channel is closed while the basin is filling; the other while the basin is emptying. The flow can be utilized coming and going.

The water-wheel, which dates far back in history, almost undoubtedly was a Chinese invention. Probably the same is true of the tide mill. At present there are many such mills in China, located on small tidal creeks, and used for cleaning and "polishing" rice.

(*Continued on page 132*)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SUN
ORBIT PRIOR TO CAPTURE
EARTH'S ORBIT
HOW THE SUSPECTED BODY WAS CAPTURED BY TERRESTRIAL GRAVITATION.
TO A SPECTATOR ON THIS TINY GLOBE, THE EARTH WOULD PRESENT A WONDERFUL SIGHT.
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Drawn for POPULAR SCIENCE MONTHLY by Scriven Bolton, F.R.A.S.

Has Our Earth a Second Moon?

By Scriven Bolton, F.R.A.S.

IF YOU are interested in popular astronomy and if you own or have access to a small telescope, you have the opportunity of a lifetime to make a momentous discovery, one that might eclipse the discoveries of the world's greatest observatories. You have a good chance to find a suspected second moon to the earth—a comparatively tiny meteoric ironstone ball some four or five hundred feet across, without atmosphere and frozen to the core.

This strange little body, pulled from its course by gravity, is believed to revolve around our earth once every three hours, traveling at a speed of about 3½ miles a second. Its orbit may lie about 2500 miles from the earth's surface. A modest three-inch telescope should reveal it.

Watch to see if a small black speck ever passes across the solar or lunar disk. If the suspected second moon really exists, it is reasonable to assume that occasionally it must pass between us and the sun and moon, moving rapidly across in six or eight seconds. Reports have been received that such a body has been observed, but these must be substantiated.

Your LEGS—Yardsticks *The Newest* Theory *of*

Henry Ford
Long-legged, short-bodied type of man

IF YOU have a small body and long arms and legs, the chances are that you are highly intelligent and will find success in some kind of brain work.

If you have a large body and short arms and legs, brain work probably is not your forte, and you would do best to follow some manual trade, or at least a line of work requiring steadiness and accuracy rather than quickness of mind.

If you are of a normal type—that is, if your limbs are not disproportionately long or short in comparison with the size of your body—you may be either intelligent or unintelligent. Whether you are suited for brain work or manual labor cannot be told accurately from your bodily measurements.

These in effect are the conclusions science has reached as a result of the latest investigations in the field of physiological psychology. You will notice that I have not stated that intelligence is an attribute of *only* small-bodied, long-limbed men. One of the most brilliant men I know, a scientist of international reputation, is squat and short legged, and probably would be working as a day laborer if the classification given above held true in all cases.

On the other hand, within my sight as I write this is a gang of a dozen laborers, two of whom are long-legged, long-armed, short-bodied men, who, if bodily conformation were an infallible index to intelligence, ought to be occupying important executive positions. You probably can suggest other similar exceptions from among your acquaintances.

Science has found, though, that the size and proportions of the body apparently supply a most reliable way of predicting the intelligence. Recently Dr. Sante Naccarati, of New York City, well-known specialist in nervous and mental disorders, conducted a test of this theory among about 300 students of Columbia University. The results tend to show unmistakably that a very definite relationship exists between bodily structure and intelligence, this despite the fact that no very unintelligent individuals would be found among a group of college students. If unskilled workers had been included, the relation between intelligence and bodily development almost certainly would have been more striking.

Orville Wright
Long-legged, short-bodied type

THE first group examined by Doctor Naccarati consisted of 75 men. All of them had taken a three-hour intelligence test, and their standing in it was known. As a first step in determining their bodily proportions, the volume of each man's chest was found by measuring its height, breadth, and thickness and multiplying the measurements—exactly as you would find the volume of a box. Then the volumes of the upper part and lower part of the abdomen were determined in a similar way, and the three volumes added together to give the volume of the entire trunk. Next, the length of one arm was measured from shoulder to wrist, and the length of one leg from hip to ankle, and these lengths added. Finally a relation was established between the combined length of limbs and the capacity or volume of the body by dividing the former by the latter. The result is called the "morphologic index," or guide to bodily structure. It tells instantly to what bodily type a man belongs, just as dividing a man's weight by his height would tell you whether he is too light or too heavy for his height.

Measurements in the test were taken in centimeters, and it was found that the students varied in morphologic index between 350 and 750, those with a high index belonging to the small-bodied, long-legged type, those with a low index belonging to the large-bodied, short-legged type. If the measurements were in inches, the index would vary between .022 and .048.

IT MAY be noted here that the morphologic index is approximately the relation of height to weight. This means that you can determine your bodily type roughly if you divide your height in inches by your weight in pounds and multiply the result by 100. If the result is more than 50, you belong to the small-bodied, long-legged type. If it is between 50 and 35, you belong to the normal type. If it is less than 35, you are of the large-bodied, short-legged group.

Our tests showed that the morphologic index is not a 100 per cent guide to intelligence. For example, one student belonging unmistakably to the large-bodied, short-legged type, proved to be one of the best students in his class, while at least three others of the group examined, though having the small bodies and long legs that betoken intelligence, have been

Four Outstanding Men

ON THESE pages are pictured the four Americans recently selected by President M. L. Burton of the University of Michigan as the outstanding men of the twentieth century. Two of them—Henry Ford and Orville Wright—belong to the long-legged, short-bodied type of man, a type which, according to the new theory explained by Doctor Garrett in the accompanying article, indicates high intelligence. The other two—Thomas Edison and Theodore Roosevelt—belong to the normal type, midway between the long-legged and the short-legged types. Note that the short-legged type, said to indicate low intelligence, is not represented.

Whether or not you agree with the new theory of the relation of stature to intelligence, you will be interested in the results of its application in scientific laboratory tests, as described by Doctor Garrett.

# of BRAINPOWER

Intelligence

By Henry E. Garrett, Ph.D.
Department of Psychology, Columbia University

forced to leave college on account of scholastic deficiencies since the test was made.

But on the whole, comparison of the bodily measurements of the students with their tested intelligence showed undoubtedly that so far as the possession of general intelligence is concerned, the chances are very much in favor of the man who possesses a small body and long legs.

OF THE 75 men examined, 35 showed high intelligence, 19 of these from the 25 who made up the small-bodied, long-legged group. Only six of this group showed medium or low grades in the intelligence tests. Of the 37 who made up the normal group, 14 showed high intelligence and 23 medium or low, while of the 13 large-bodied short-legged men examined, only two showed high intelligence.

Expressed in percentages, the results mean that 76 per cent of the small-bodied, long-legged men, 40 per cent of the normal men, and 15 per cent of the large-bodied, short-legged men showed high intelligence.

The results of this first experiment were so favorable that, in order to test further the relationship between bodily structure and intelligence, Doctor Naccarati examined another group of 221 men. The same general result was obtained.

It is surprising how thoroughly Doctor Naccarati's conclusions seem to be borne out in the case of many well-known men. Henry Ford, John D. Rockefeller, General Pershing, Booth Tarkington, and David Wark Griffith might be named as the outstanding Americans of this generation in their particular fields. All of them are long-legged men with short bodies.

WASHINGTON and Lincoln and Woodrow Wilson likewise were of this type. President Coolidge, the late President Harding, Andrew W. Mellon, Secretary of the Treasury and one of the world's leading bankers, and William G. McAdoo, former Secretary of the Treasury, also must be included in the small-bodied, long-legged class. In the world of invention, Tesla, Marconi, the Wright Brothers and a host of others are typically long-limbed men with small bodies.

Edison belongs to the normal type. So did Theodore Roosevelt. So does David Belasco. Charles Evan Hughes and Elihu Root appear to be of the normal type, though removed from the short body, long-legged type by a narrow margin.

Nobody will deny that all of these men are of superior intelligence, yet all but two or three of them are small-bodied, long-limbed men.

The names of two other men occur to me—Jack Dempsey and Luis Angel Firpo. They are almost as well known as any of the eminent men I have mentioned, yet not even their staunchest admirers would claim that they possess as much intelligence as any of those named in the previous paragraph. Both of them fall in the class of large-bodied, short-legged men of the low normal group.

Now, this relationship between bodily proportions and intelligence cannot, of course, be merely accidental. There must be some scientific reason for it. Viola, an Italian scientist, offers the opinion that the man with the small body and long legs has advanced further in the scale of evolution than the normal man or the man with long body and short legs, just as the animals we know today show in their bodily conformation and abundant brain capacity an advance over the huge, unwieldy, short-legged prehistoric monsters.

Thomas Edison
Normal type

Theodore Roosevelt
Normal type

The most tenable explanation, however, is based on facts given by endocrinology — the study of the ductless glands; those mysterious little organs, which through their internal secretions have been found to influence mental and physical growth. Probably the best known of these is the thyroid, which is in the neck, close to the windpipe.

PERSONS whose thyroid glands are active usually will be of the small-bodied, long-legged type. They are likely to be alert and active, to have a vivid imagination and a good memory. Sometimes they are excitable, and, if their thyroids are overactive, they often are dreamers and theorists, rather than doers.

The large-bodied, short-legged man, on the other hand, is likely to have a thyroid gland that is not especially active. Though he often has greater endurance than the man with small body and long limbs, he is slower mentally and physically. This type often makes the cautious hard-headed business man—the doer rather than the thinker or dreamer.

How to Test Yourself

TO FIND whether you belong to the long-legged, short-legged, or normal type of man, first measure the volume of your trunk, dividing it in three sections;

1. Measure length of chest bone, depth of chest, and width between armpits. Multiply dimensions.
2. Measure from chest bone to end of ribs, width and depth of middle chest. Multiply dimensions.
3. Measure from end of ribs to hip bone, width and depth of waist. Multiply dimensions.

Add these three volumes to obtain total volume of trunk. Now measure the length of one arm and one leg.

Divide combined length of arm and leg by total volume of trunk. The result will give a fraction — your "morphologic index." If this is between .035 and .022, you belong to the short-legged type; if between .035 and .048, to the long-legged type. Normal is about .035.

Storming Earth's Highest Citadel

Mount Everest's Desolate Summit a Challenge to Man's Endurance

By Raymond J. Brown

SOMEWHERE on the Tibetan plains a band of a dozen explorers is pushing forward on the first leg of a most tremendous adventure. They are preparing to storm the loftiest citadel Nature has reared on earth—Mount Everest, whose snow-capped peak rises 29,141 feet above the sea, dwarfing the surrounding mountains of the mighty Himalayas. Preparations for the actual ascent were completed early this year.

The expedition is under the auspices of the Mount Everest Committee of London, England, and is the third attempt to scale the mountain. All its members are veteran climbers. One of them, George Leigh Mallory, took part in both the previous assaults on this desolate spire of the earth. Another, Capt. Geoffrey Bruce, brother of Brig.-Gen. C. G. Bruce, commander of the expedition, shares with Capt. George I. Finch the distinction of having ascended, in the last attempt in 1922, to within 1700 feet of the summit—a height of 27,441 feet. This is the greatest altitude ever reached by man, except in an airplane.

As a result of the two previous expeditions—a reconnaissance in 1921 and the actual attempt to reach the summit in 1922—every aid that science and ingenuity can contribute has been summoned to insure the success of the present venture and to guard against accident.

The approaches to the mountain and the paths to be traversed by the expedition in its climb have been mapped and charted. Supply camps have been located at points most advantageous to the climbers. The equipment includes everything that will contribute to comfort and safety and conservation of strength during the tortuous ascent.

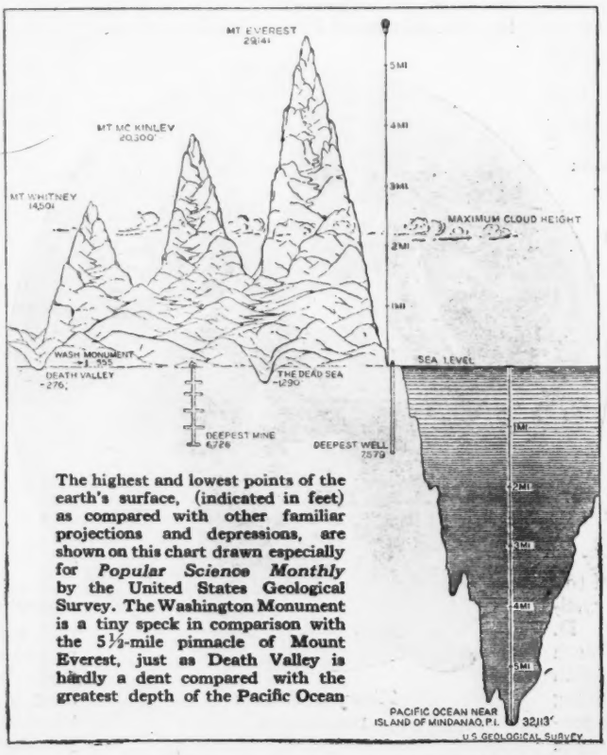
OXYGEN, for example, is to be carried to the climbers in tanks to compensate for the deficiency of this life-giving gas in the rarefied air enveloping the upper portions of the mountain. The members of the expedition know that they can climb to within about two miles of the top with relatively little difficulty. They are reasonably certain, after the spectacular feat of Captains Bruce and Finch two years ago, that the most hardy of them can ascend a mile and a half farther. But the last half-mile—can they conquer that? Nobody knows.

Nature controls the situation through the physical capacities with which she has invested man. Can a man at a height greater than 27,000 feet, develop the energy to walk or drag himself higher?

In scaling a precipitous mountainside, covered with ice and snow, possibly under the necessity of cutting a foothold for himself with every step he takes, a man uses up a tremendous amount of energy. He literally is burning up the tissues of his body, a loss that can be made up only by the oxygen he breathes. The atmosphere near the summit of Everest, containing less than half as much oxygen as the atmosphere at sea level, cannot supply the loss. Consequently, the normal functioning of the body is interfered with seriously.

The principal factor, then, in the assault on the heights of Mount Everest is the physical ability of the members of the expedition. Natural obstacles, of course, are there in plenty. The sheer slopes of a mountain more than five miles high would present almost overwhelming difficulties to the climber even if the atmospheric conditions did not offer their peculiar hazards, as in this instance.

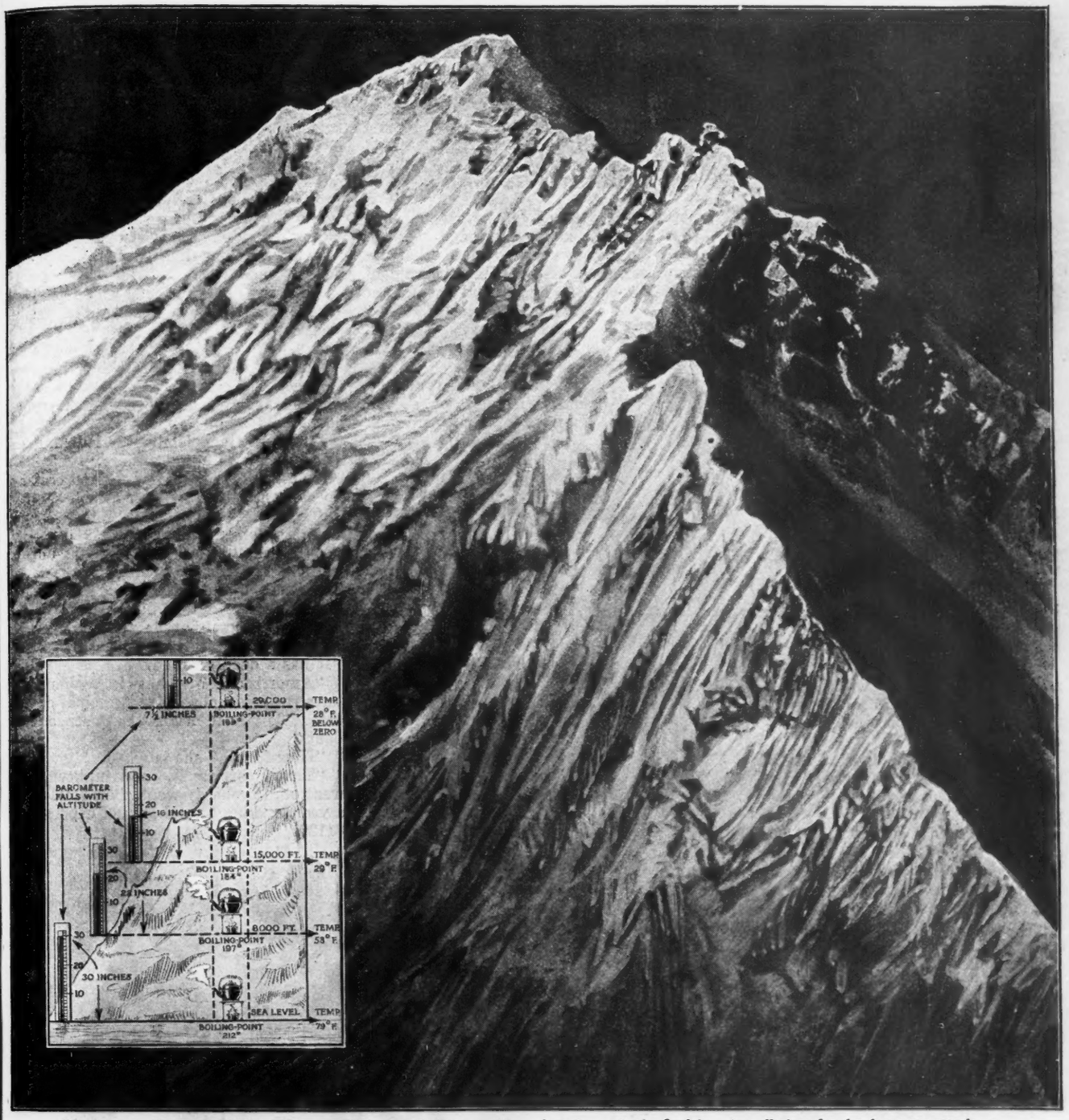
Snowslides and landslides cause the topography to undergo extraordinary changes. One tremendous snowslide in the last expedition took the lives of seven



The highest and lowest points of the earth's surface, (indicated in feet) as compared with other familiar projections and depressions, are shown on this chart drawn especially for *Popular Science Monthly* by the United States Geological Survey. The Washington Monument is a tiny speck in comparison with the 5½-mile pinnacle of Mount Everest, just as Death Valley is hardly a dent compared with the greatest depth of the Pacific Ocean

Members of the 1922 expedition fighting their way, step by step, up the treacherous slope of Mount Everest. The climb is one long, tortuous test of human endurance. The adventurers not only must use up tremendous bodily energy scaling precipitous ice-covered slopes, in constant peril from snowslides, landslides, and terrific storms, but their strength is sapped by lack of oxygen in the air

Pausing for a brief rest during the ascent. Climbers of the 1922 Everest expedition are shown wearing smoked glasses, their faces coated with lampblack, as protection against the danger of snow blindness. Strange as it may seem, while the terrific cold saps their waning strength and nips at their hands and feet, the sun beats down with terrific intensity. They are always in danger of sunstroke



The ice-capped summit of Mount Everest, highest peak in the world, which twice has defied the attempts of men to scale its desolate face. This remarkable photograph shows the rugged slope up which the third expedition this summer will attempt to make the final dash to the top. The mountain consists of a massive central pinnacle from which radiate five ridges, four in the northern area and one on the southeast. The longest ridge, to the north, culminates in a secondary spur known as North Peak, separated from the central peak by a narrow, wind-swept pass. This depression, 23,000 feet above sea level, is to be made the final jumping-off place for the desperate attack on the summit.

The inset illustrates how the diminishing atmospheric pressure at increasing altitudes, indicated in round numbers, causes the barometer to fall and reduces the boiling temperature of water, with the result that while the water actually may be boiling, it is not hot enough to cook meat, potatoes, or other foods. This condition is encountered even before the 15,000-foot altitude is reached. The boiling-point drops about one degree Fahrenheit for every 590 feet that is climbed

native aids. Fierce gales of almost unbelievable velocity sweep about the upper portions of the mountain, where the snow is dry and soft as sand. But the greatest difficulties of all are those that arise from the natural requirements of the human body.

Take the matter of food alone. The climbers are limited in the kind of food they can take, not so much because of the difficulties of transportation as because of the difficulty of cooking it. The boiling point of water drops one degree for each 590 feet the water is carried above sea level. At sea level the boiling-point is 212° F. At 15,000 feet it is only 184 degrees, and near the summit of Mount Everest it drops to approximately 168 degrees.

So it is that vegetables and other foods that the members of the expedition are accustomed to eating boiled cannot be boiled when at an altitude above 8000 feet. The water will boil away without becoming hot enough to cook the vegetables. This makes it necessary for the members of the expedition to eat food to which they are unaccustomed, a factor that is bound to exert an effect on their physical powers.

The low boiling-point of water at high altitudes also makes it impossible for the climbers to foster their faltering strength by the stimulating effect of hot drinks.

Then there is a condition called "mountain sickness" to which even the most experienced climbers are subject. None escapes it, it is said, once an altitude of 20,000 feet or so has been attained. This malady undoubtedly is related closely to the breathing of rarefied air and the con-

(*Continued on page 141*)

Adventures in Home Ownership

Chapter II—How We Financed Our Purchase

By Phil M. Riley

Noted American Authority on Architecture and Building

The story of the first adventures of Jim and Marion Hunter in their search for a ready-built home was told entertainingly by Mr. Riley in last month's issue. After inspecting a number of houses that offered such objections as careless construction, old age, and undesirable neighborhood, Jim and Marion finally found their heart's desire, only to discover that the price apparently was beyond their reach. Now read on:

"TEN thousand dollars!" exclaimed Jim Hunter, repeating the price of the house that they had hoped to buy—the price his wife had read from the real-estate list. "Whew, Marion, that's a lot of money, isn't it?"

"Well, a lot more than we've got," she admitted ruefully.

"Unfortunately, one gets but small houses for big money these days," I reminded them.

Marion was quick to sense the imminent collapse of her hopes in the tone of Jim's voice, but evidently was unwilling to give up.

"Of course these are asking prices," she said, pointing to the list and appealing to me. "Do you suppose the owner of this house could be induced to take less?"

"Possibly a few hundred less for all cash," I told her, "though hardly more than $500 and probably not nearly so much."

"Even so, we haven't half enough money!" she cried in obvious despair. "Oh, Jim, isn't it wretched to be so poor?"

The expression of Jim's face as he watched her seemed to register several emotions. I thought I could read in his eyes genuine sorrow, hurt feelings, and a spirit of tolerance.

"IT IS, little girl," he agreed gently; "but fortunately I have prospects. Don't forget that."

Then he turned to me.

"On what terms do you suppose I could buy the house?" he asked.

"That depends on how much money you can put into it at the start," I told him. "The more the better, because the carrying charges are so much less. With 40, 30, or even only 20 per cent of the purchase price in cash, you usually can buy any house, for some bank or loan association will carry the balance as a loan secured by a first mortgage. I have known persons to buy their homes with little or no cash, but it is an unsound practice, usually resulting in an overwhelming burden or even financial disaster."

"What proportion of the investment is a bank generally willing to carry?" asked Jim.

I explained that most banks prefer not to carry more than 50 or 60 per cent of the total value, and under some state laws cannot do so. Yet building and loan associations will carry as high as 80 per cent. I pointed out that, if necessary, part of the amount can be carried on a short-term second mortgage, which the builder or owner may take, otherwise some private investor. But the rate of interest would be higher and a bonus or commission up to 10 per cent sometimes is charged.

"The robbers!" Marion interrupted.

"Not at all," I assured her. "Holders of second mortgages take more risk and are entitled to a higher return to cover occasional losses. Builders often have to sell their second mortgages at from 20 to 25 per cent below their face value to obtain more money for carrying on their business. The good character of a home-seeker usually enables him to secure a second mortgage on reasonable terms."

Jim got out his note-book and began jotting down figures

Jim suggested that he might borrow some money on his life insurance.

"No doubt you could," I agreed, "yet it's an improvident thing to do. It deprives your family of the full protection your life insurance should secure. But very likely you could negotiate a real-estate mortgage loan with your insurance company. Many companies engage in such business while at the same time discouraging policy loans."

"Getting down to facts, we've got just $4000 to put into a home," Jim finally confided.

"FINE," said I. "That being the case, we can easily get a bank to carry the balance of $6000 on a first mortgage loan."

"Won't it be splendid?" cried Marion, her eyes sparkling once more.

"Yes, but what is it going to cost us to carry the house?" Jim asked.

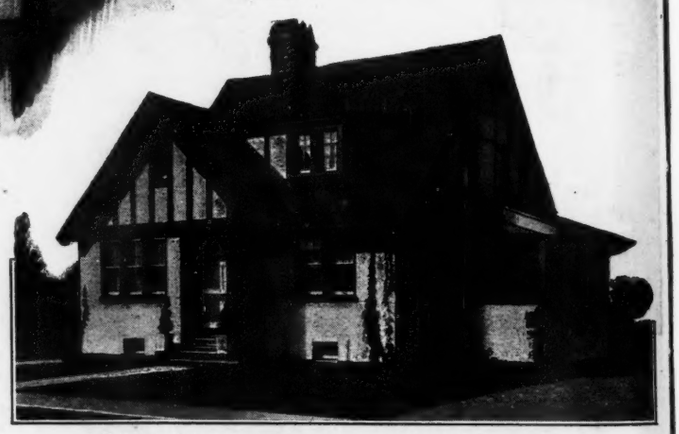
"Well," I explained, "interest and amortization at the rate of 12 per cent of the total loan annually, assuming interest at 6 per cent, will enable you to cancel the whole debt in about 12 years and will amount to $720 a year."

"What does that big word mean?" Marion asked with a puzzled frown. "It has a deadly sound."

"Amortization? That is a banker's term for paying back the principal of the loan. To you it means the death of the debt."

"How funny," she laughed.

"Taxes, insurance, and upkeep," I went on, "probably would be about $400 a year, making a total annual expense of $1120."



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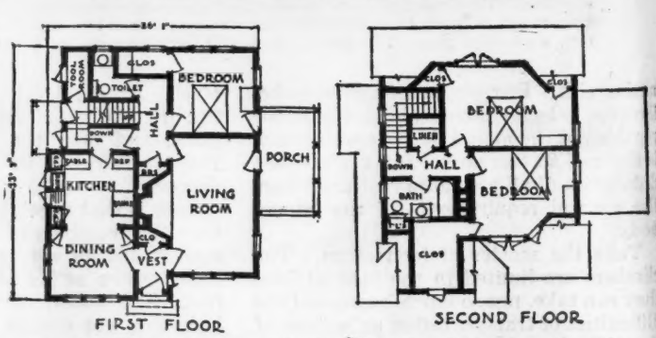


This unusually compact, yet attractive six-room semi-bungalow of the English-cottage style Jim and Marion found to be a model of economical planning, with many labor-saving devices, yet unsuited to their tastes. In most localities it should range in cost from $7000 to $8500

"To which ought to be added my loss of $180 savings-bank interest on $4000 at 4½ per cent," Jim added.

"TRUE enough," I assented; "but remember that of the $1120 annual expense only $760 would be comparable with rent the first year. The other $360 really would be savings, an investment you might call it, applied to reduce the principal of the loan. A man ought to save for some sort of investment at least from 10 to 15 per cent of his income annually, and this is a good way to save part of it. Don't forget, also, that these savings grow larger every year as the principal of the debt becomes less and the interest charges are reduced."

"The trouble is," laughed Jim, "that while a house is in a sense an investment, it pays no definite, regular interest. The savings put into it to reduce the principal of the loan are lost to us as far as possible use of them in time of need is concerned. The same is true of the interest on those savings, or $16.20 a year at 4½ per cent on $360."

"But, Jim," Marion broke in. "It seems to me that the interest on a home investment takes the form of enjoyment of your own home while paying for it and of better living conditions for the children and ourselves. Besides, we might save something when you consider the rent raises profiteering landlords are making."

"I'm afraid we wouldn't," Jim objected.

I pointed out to him that he could always raise money on his equity in a house, if he wanted to give a second mortgage.

"Yes, and pay a high rate of interest for it," Jim wisely retorted. "I'd rather have savings in the bank and merely lose the 4½ per cent interest on them."

I suggested that he ought to have both the house and some reserve savings in money.

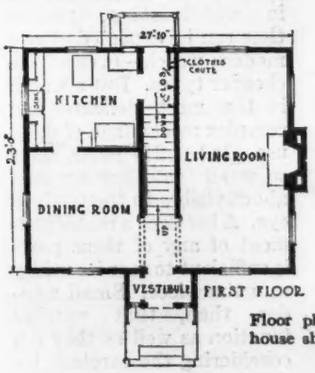
"RIGHT you are," he agreed. "And another thing we mustn't forget is the fact that heat and water must be paid for in maintaining this house, both of which are now included in our apartment rent. Water would average perhaps $20 a year. And wouldn't you say about 10 tons of coal at $150, making a total of $170 a year for these items?"

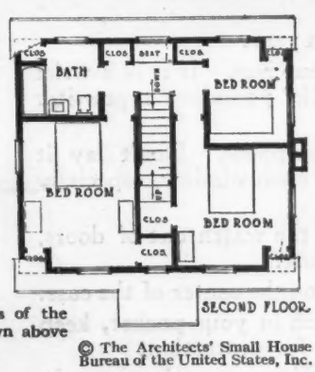
Here Jim got out his note-book and began jotting down figures. Over his shoulder I read the following summing up of his expenses:

Int. and amort.....	$720
Taxes, ins., upkeep...	400
Int. loss on $4000.....	180
Coal and water.....	170
Int. loss on $360.....	16.20
	$1486.20

"I should say," he announced presently, "that to buy and maintain this house with what ready money we have we practically would be paying out $1500 a year, as compared with the $1200 our heated apartment costs us with water included. Deducting from this latter amount the two interest items we should be saving, or $196.20, the figures show that this house really would cost us about $500 a year more than our apartment."

An inexpensive Dutch Colonial cottage of six comfortable rooms and bath. Jim and Marion decided to buy this home because it offered the best for the money. It should cost between $6500 and $7500





Floor plans of the house shown above

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"And that, I suppose, means we can't have the house," Marion sighed. She was on the verge of tears.

"I'm awfully sorry, Marion dear," Jim said, laying a comforting hand on her shoulder, "but it really would be a burden to us, I'm afraid. If there were just you and I, we might manage, but the kiddies mustn't want for anything."

"It's such a dear place," Marion said sadly, glancing about appraisingly once more. "Jim, you've no idea how I'd be willing to economize on everything in order to buy it."

"You're a good little sport, Marion," he replied; "but economizing is the way we've accumulated our $4000. There's a limit to that sort of thing and we've been sailing pretty close to it right along. I don't see how we could do very much better."

Realizing the probable wisdom of Jim's caution, I decided to find out more definitely what their circumstances were and to offer what seemed to me sound advice. Meanwhile I had been hastily consulting some copies of Manning and other family budgets, issued by banks, that I usually carry in my pocket for reference in such cases.

"Of course a man should have an annual income of from $4000 to $6000 in order to buy a $10,000 house comfortably," I hazarded, "and if he has children, it really ought to be $5000 or $6000."

"THAT'S just the point," Jim agreed. "I'm getting $4000 a year and, like many salaried men, have been violating the old rule not to pay more rent by the month than the amount of my weekly salary. But the boss has almost promised me a 50 per cent raise at the end of this year if our volume of business is maintained, and then this would be easy."

"For a family man with a $4000 income, about $100 a month ought to cover all home-carrying and operating expenses," I stated, referring to the chart in my hand. "Now may I offer a frank, practical suggestion?" Marion and Jim nodded encouragement.

"Perhaps you'll remember," I explained, "that in looking at one house today I reminded you that even buying a home must be regarded as an investment with an eye to its resale value, just as in buying a car."

"I sure do," commented Jim, "and it sounded logical to me."

"Frankly," I went on, "this house is a little too much for you to carry comfortably, and perhaps it is unwise to anticipate Jim's salary raise, certain as it seems. About double the annual income is all anybody should pay for a home. Why not buy a lower-cost place that you can carry comfortably, and when your income increases sell it and buy or build another? You would better your living conditions and I think I can guarantee that you will lose nothing. You might even make a little money by the sale, due to the growing demand for homes in this locality."

"THAT'S my idea to the last word!" exclaimed Jim. "But where can we find the house?"

To my recollection as we talked had come a development of several small houses near by, put up by a reputable builder of my acquaintance whom I knew to be satisfied with a fair profit and proud of giving good value for the price.

"I think I can find you one, or several, for that matter," I assured him confidently.

"Let's go," urged Jim eagerly.

Marion, however, showed little interest and was again looking about in wistful appraisal.

"Let me tell you about these houses, Marion," I said, to divert her mind from her disappointment. "They're a good deal like this one, only a bit smaller. I feel sure you'll like them. And, Jim," I continued, getting each by the arm and drawing them together beside me, "they're only $7000."

(*Continued on page 137*)

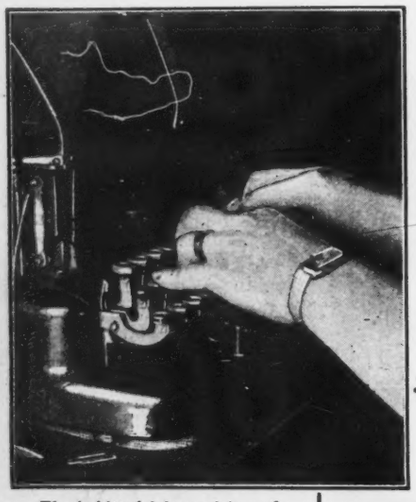
Does Your Watch Know You?

How to Befriend the Most Temperamental of Mechanical Servants

By Samuel Bernard
Expert Watchmaker

A FEW weeks ago a young man asked me to examine a large silver watch, a typical railroad man's watch; an excellent timepiece, too, I knew as soon as I saw it.

"I bought this a couple of weeks ago," he told me, "and I'm afraid I've been stung. I got it from a locomotive engineer who lives near me. He told me it hadn't gained or lost more than a few seconds in 10 years; that he'd been running a train



The habitual jolts and jars of pounding typewriter keys are ruinous to watch accuracy

by it. He said the only reason he was selling it was because the railroad had given him a new watch. I thought I was getting a prize when I bought it from him, but it's been losing about two minutes a day ever since I began carrying it."

Even before I opened the case, I was quite certain there was nothing wrong with the watch, and, after making a hasty examination, I told the young man there wasn't.

He looked at me blankly. "But it hasn't been keeping time," he objected.

"That's merely because you and the watch haven't become acquainted yet," I told him. "The watch hasn't got used to your ways. For 10 or 15 years it has been carried by a locomotive engineer, and it has been used to the vibration of the locomotive. It has become accustomed to being carried at high speed in the temperature of a locomotive cab. It has been in the habit of starting out for the day at a certain time and of being put away for the night at a certain time.

"You probably work in a well-heated office. You get up later in the morning than does the engineer, and you go to bed later at night. Probably you wind the watch at an entirely different time. The watch has resented being disturbed in its accustomed routine—it misses its constant vibration—and the only way it has of showing its objection is by running slow."

"You talk as if the watch were alive," he said.

"Exactly," I agreed. "Of all mechanical devices we use, a watch comes nearest to having life, senses, and feelings. It reacts to cold and heat, dampness and dry air, recognizes good treatment from bad; in fact, it's as sensitive to the way it is cared for as a pet dog would be.

"A watch even has temperament which it acquires rapidly according to the temperament of its wearer. That's the trouble with your watch. Your temperament is different from that of the former owner, and the watch hasn't had a chance yet to adapt itself to the way you do things. Give it a little more time to get used to you and your ways. Just move the regulator a bit to correct the time that the watch is losing now. You can do that as well as I could do it for you—and I'm sure you'll find the watch adjusting itself to you in a short while."

That young man's attitude was typical of the average watch owner. When you buy a watch, you expect it to keep perfect time. If the watch fails to do so, it never occurs to you that the fault may lie in yourself—in the way you treat your timepiece. After all, with the progress that has been made in watchmaking, perfect time can be expected of any modern watch—even of the cheaper types. But a watch is the most delicate and complex mechanism of daily use. It has 211 parts, some so small that they are just about visible to the unaided eye. A break or a maladjustment of any of these parts is sufficient to mar its utility as a timepiece. Small wonder, then, that watches function as well as they do, considering the careless, indifferent way we care for them!

Hanging the watch near an open window, exposing it to damp air, rusts the parts

How to Make Your Watch Keep Good Time

MR. BERNARD says:

After you buy your watch, have it regulated to fit your gait.

Treat it gently. Don't drop it. One bad fall may ruin it.

See that it is oiled once a year.

Guard it against jolts and jars. If it is a wrist watch, don't wear it while pounding typewriter keys.

Keep it away from dampness. Don't lay it down or hang it up near an open window, especially at night.

Never open the back of the watch out of doors, or where the air is full of dust.

In closing it, never press on the center of the case.

When carrying your watch in your pocket, keep the face next to your body for protection.

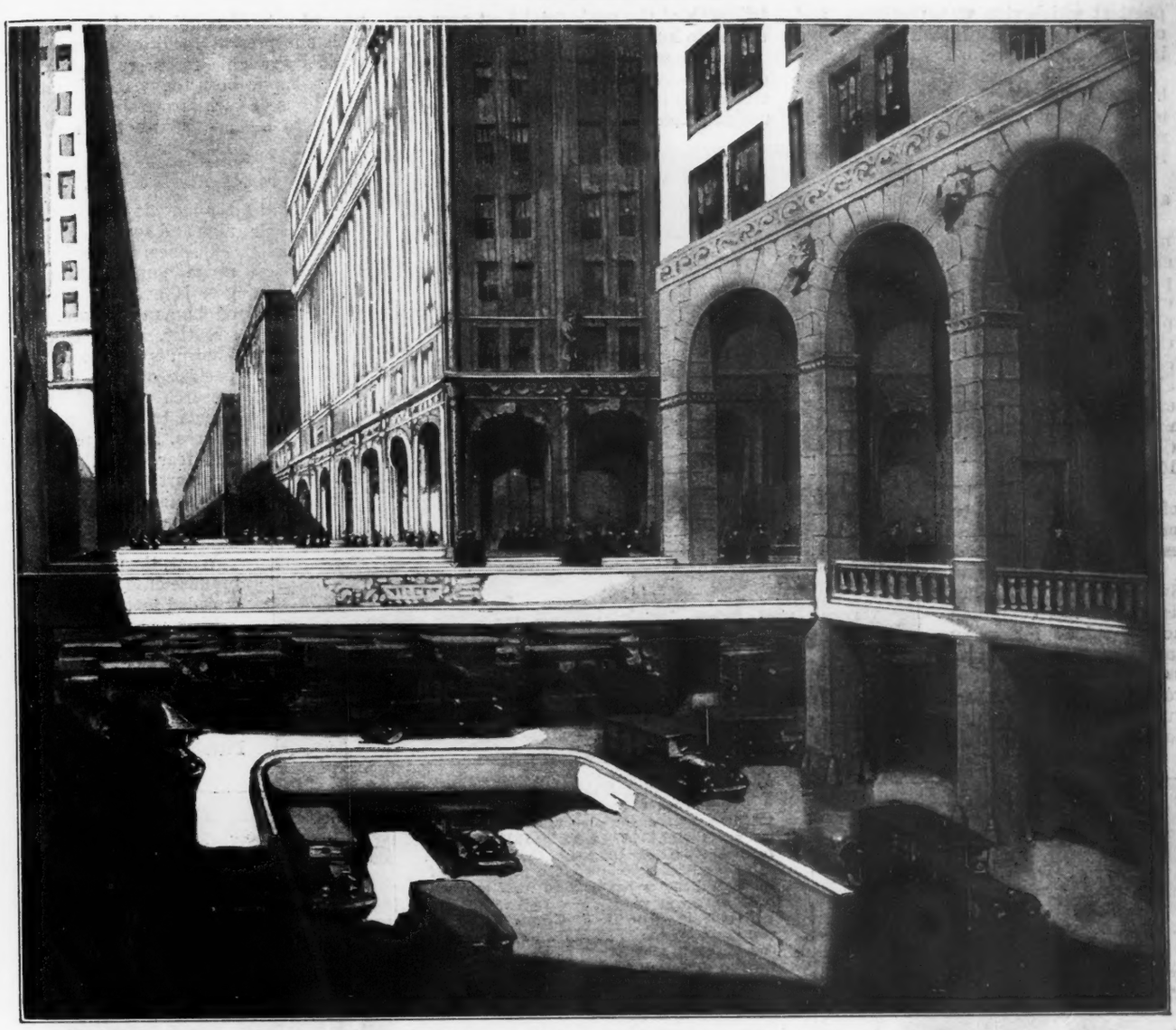
Wind your watch every 24 hours, and at exactly the same time, to the minute, each day.

Be careful not to drop your watch. One fall may ruin it as a timekeeper

Have you ever considered what a really marvelous device a watch is? To make one requires no fewer than 3733 distinct operations, involving about a year's work. Many of the parts cannot vary so much as one two-thousandth of an inch in any dimension. The balance wheel alone requires scores of operations by the machines used in its manufacture. Yet, perfect though the machinery is, it is impossible to produce two balance wheels of exactly the same size and weight! They must be weighed after manufacture and sorted according to size.

Part of the mechanism strikes 18,000 blows an hour—157,000,000 in a year.

(*Continued on page 142*)



Triple-deck street corner in the crowded city of the future—a solution of the ever-increasing traffic problem proposed by Harvey Wiley Corbett, president of the Architectural League of America. Streets would cross one under the other, thus eliminating cross currents of vehicular traffic. Pedestrians would use an elevated sidewalk, bridged at all streets in both directions, ending the clash of foot and wheel traffic

Can Science Save a Crowded World?

By Lieut.-Comm. Fitzhugh Green, U.S.N.

Author of "Perils of Polar Flight"

Take the world we live in; add a touch of speculation on the rushing wonders of science; couple these with the keen mind of a brilliant naval officer, and you have this startling prediction of an amazing world future.

HAVE you ever been caught in a subway jam or a football crush, and have you felt that little instinctive shudder of irritation at being pushed hither and thither against your will by other unhappy mortals just as helpless as yourself?

A hundred years from now the whole of life may be like that!

The population of the earth has doubled in the last 90 years. Today it is estimated at 1,747,000,000.

America has done her share. Our recent United States Census Report says: "The net addition to the nation over deaths and departures for the last 10-year period (1910-1920) averaged nearly 4000 persons per day"!

Increase the perspective and the figures are even more astounding:

The population of the United States has been doubling itself approximately each 30 years during the last century. It was 25,000,000 in 1850, 50,000,000 in 1880, and 100,000,000 in 1910. If this rate of increase continues, it will have grown to 700,000,000 in less than 100 years!

Statisticians of Johns Hopkins University, after careful computation, tell us New York will pass the 12,000,000 mark by 1933. By the end of the century its population will have reached the huge total of 29,000,000 inhabitants! Los Angeles, which is growing three times as fast as New York, may then count 40,000,000 sunburned Californians!

They make you a little breathless, don't they, those figures? Like watching the Twentieth Century Limited go whizzing by; only this one keeps on whizzing.

And all humanity is aboard!

One view of this astounding problem still widely held lies in what is known as the "Malthusian theory." Robert Malthus was a Jesuit priest of London. In the year 1798 he started an argument on the subject of population that still is far from ended.

Malthus viewed man's future on the earth with melancholy eye. He held that the race multiplies faster than its means of subsistence can be made to follow; that ultimate famine is inescapable. Whence, he concluded, as a result of poverty and hunger, men's morale must lower to a

point at which vice, war, pestilence, and other "natural controls" will provide the inevitable check.

Those who back this pusillanimous hypothesis forget the deepest roots of man's indomitable character. These roots are Courage and Imagination.

But what are we doing about it?

First of all, we have made a survey of the situation. The figures on page 39 show us what to expect in the matter of population. Some idea of their accuracy may be gained from the fact that already our census experts can predict to a fraction what the population of the United States will be 10 years from now.

Next, comes a survey of the world's resources, present as well as future; especially power and food.

Arrhenius, the famous Swedish scientist, has listed and has computed actual values for every source of energy open to us with our present development of scientific knowledge. They are: Solar radiation, air currents, evaporation, flowing water, storage in plants, coal, and oil.

Arrhenius says that the total water power, or "white coal," in the world is 745,000,000 horsepower. He declares that England's coal mines will be exhausted in 200 years; that less than a trillionth of the sun's total heat ever can be put to human usage. And so on.

Food as we know it today is an equally definite matter. Take the grain supply, which is the most economical means of utilizing land. The land area of the earth (exclusive of the polar regions) is 33,000 million acres. If we could raise 23 bushels of food corn a year on every acre, the total yield would be but 752,400 million bushels.

But we know that a fair figure for consumption is about 5.7 bushels a person annually. The answer is that if every available square inch of dry land were cultivated to the best of our present ability, the earth could support only 50,000,000,000 people, or about 25 times the number we have now.

Today we are facing the grimmest realization man has ever met. This is it:

Humanity is in danger from itself. Not war, nor famine, nor disease; but *overpopulation.*

Or, putting it another way: At the present rate of population increase, even with our present facilities for using the world's available resources of food and power, babies born today may live to see conditions of such intolerable overcrowding as to make existence but a ghastly nightmare.

Science alone promises salvation. For science, though slow, is indomitable and sure.

Science, despite its long-range guns and poison gas, is ever on the side of human welfare. The scientist, if the truth be known, is the most ardent pacifist of all. Witness research workers' tireless efforts to guard us from disease, storm, pain, fire, and fear of early death; to entertain, to enlighten, and safely to convey us where our childish whims desire.

What, then, is Science's promise of life in the overcrowded future?

First—possibly before the year 2000—a world of conurbations. (*Con*, together, plus *urbes*, cities; literally, a number of cities joined.) New York, Pittsburgh, and Chicago, with their innumerable suburbs, already are typical conurbations of a generation hence. It is not difficult to picture what the inner focus of such a population center will be like. Even today in our large cities, traffic is out of hand. It is evident that we must shift to streets in "decks" or "levels," subways, truckageways, motor-vehicle-ways, and on top a way for hordes of pedestrians.

(*Continued on page 133*)

A glimpse of what science has in store for the crowded super-city of the future is furnished by John M. High, Jr., a young inventor of Riverdale, N. Y., shown above with the "wireless city" he has constructed in his laboratory. Incandescent lamps and even toy motors installed in miniature houses and factories are made to operate by radio-frequency currents transmitted from a generator near by. From his experiments he believes it will be possible for an entire community to receive its heat, light, and power by radio from a central station perhaps hundreds of miles away

ABOVE is a typical sidewalk scene in the New York City shopping district. Statisticians say that the population of New York will pass the 12,000,000 mark by 1933, and will reach 29,000,000 by the end of the century.

During the last century, the population of the United States has doubled itself approximately every 30 years.

On the basis of U. S. Census figures of growth during the 30 years from 1890 to 1920, and excluding such factors as possible annexations or detachments of territory, the populations of other of our largest cities by the middle of the twentieth century may be estimated conservatively as follows:

FIGURES BASED ON U. S. CENSUS

	1890	1920	Per cent increase	1950?
Chicago	1,099,850	2,701,705	145	6,619,177
Phila.	1,046,964	1,823,779	74	3,173,575
*Detroit	205,876	993,678	382	4,789,228
Cleveland	261,353	796,841	205	2,430,365
St. Louis	451,770	772,897	71	1,321,653
Boston	448,477	748,060	67	1,249,260
Baltimore	434,439	733,826	69	1,240,166
Pittsburgh	343,904	588,343	71	1,006,066

*In estimating the 1923 population of Detroit, the Census Bureau says: "the growth from 1910 to 1920, if projected, gives a figure believed to be considerably in excess of the actual population"

Congested motor traffic along Fifth Avenue, New York. In the last 10 years the number of motor vehicles in the United States has increased from 1,287,000 to 14,500,000! Will the next generation see super-automobiles that will cost but a song and will never need repairing, as well as radio-controlled roadster airplanes to carry the suburbanite to his place of business in the city?

Fun and Profit in Riding Hobbies

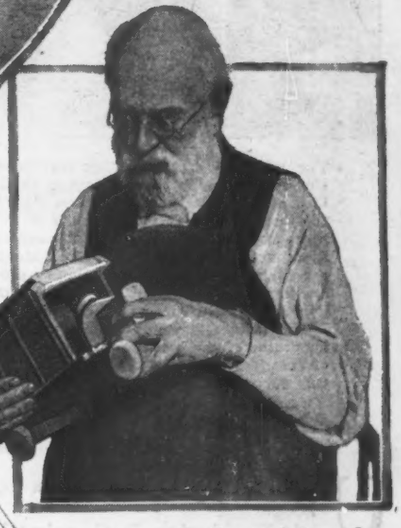
Interesting People Who Find Happiness in Unusual Pastimes

A woodsman by instinct, Edwin Black, of Greencastle, Ind., finds in his hobby—making plaster casts of animal and bird footprints—the pleasure of adventure combined with scientific interest. He has a large collection of these casts. Like fingerprints, no two are alike. He is shown above making a cast of a raccoon's footprint

During the Civil War, Mrs. Ella Fisher, of San Angelo, Tex., then a girl in her teens, began making fans of turkey and peacock feathers as a diversion. For years she made fans as gifts for friends. Now her hobby, besides giving her a pleasurable occupation in old age, is bringing her a comfortable income. She is shown above at her work

Until a few years ago, Norman La Plane, of San Francisco, Calif., was a machinist by trade. Now that he has become a full-fledged sculptor, machinery is his pastime. His workroom is a combination machine shop and studio

Even an ancient suit of Oriental armor has been transformed into a timepiece by Fred W. Jansen, of New York City, who has collected and constructed a remarkable assortment of odd timepieces. The face of the clock is designed on the metal breastplate of the armor, as shown in the picture above

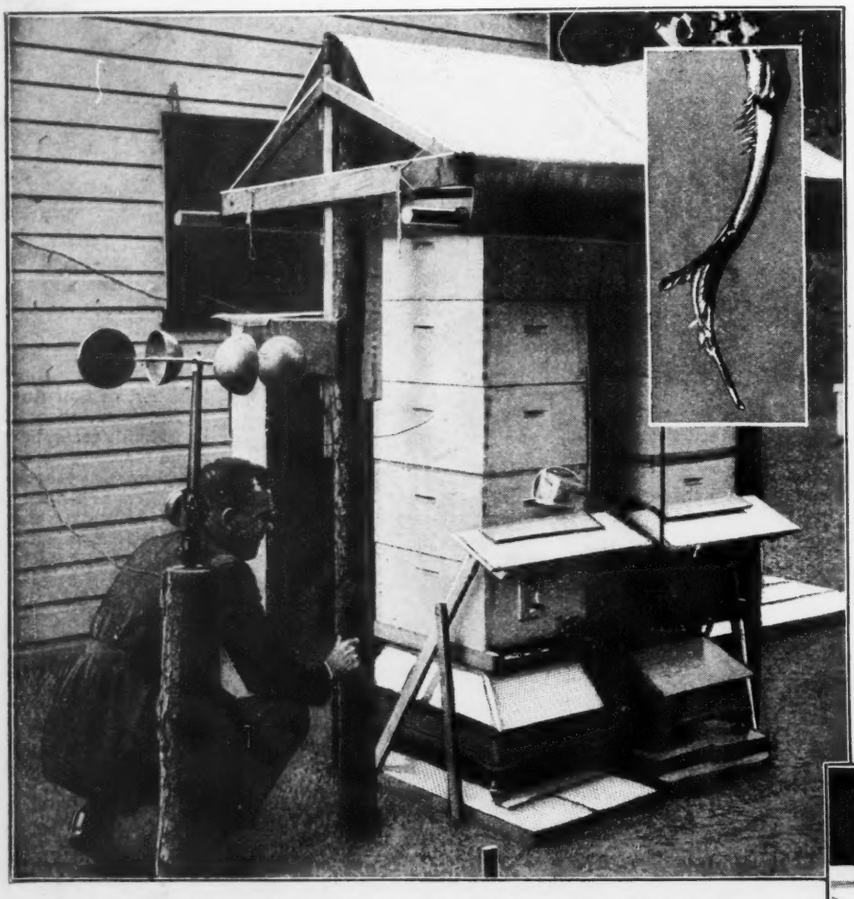


In the workshop of the Philadelphia Old Men's Home, Dr. Alfred Benjamin Rice, the oldest inmate, busies his gnarled but agile fingers making toys. At the age of 92 he finds in this hobby a useful pastime. He is shown above holding a toy motor-truck constructed at his workbench

Built at the workbench of a ship's carpenter in 1000 spare hours and at a total expenditure of $200, this model power ship, now on exhibition at the University of Washington museum, is said to be one of the most perfect ship models ever built. The builder has incorporated every detail that is found in a full-sized ship

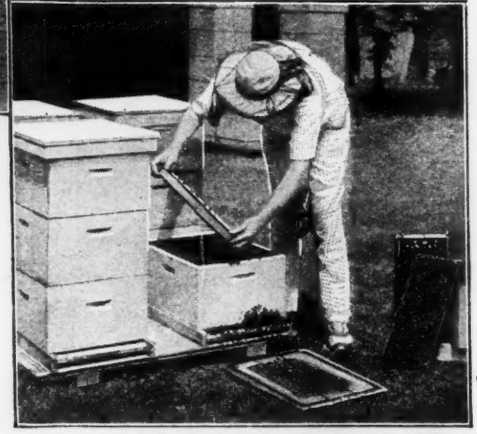
A Time Clock on the Honey-Bee

Nature's Most Industrious and Orderly Workers Are Checked and "Fingerprinted" on Uncle Sam's Bee Farm



The miniature insect weather station at Uncle Sam's bee farm, Washington, D. C. Delicate electrical thermometers record the temperatures in various parts of the hives every five minutes. By this means experimenters obtain valuable facts about the effects of temperature on honey production, and determine which breed of bees is best suited to certain climates.

The inset shows the honey-gathering apparatus of the bee (photo by courtesy of Principal Pictures Corporation). With this suction tool the bee extracts from flowers their nectar, which it carries home in an abdominal honey-sac. On the way to the hive, a minute drop of acid secretion is added to the nectar in the bee's body, beginning the transformation from sweet water to honey. Reaching the hive, the nectar-gatherer is greeted by a home worker who, mouth to mouth, drinks from the honey-sac of the new arrival, emptying the contents into its own honey-sac and adding another portion of acid, thus doubly charging the nectar before pouring it as honey into the cell of the comb



A government bee expert, protected by a veil, examining bees at work in an experimental hive

By George H. Dacy

UNCLE SAM has become a bee-keeper.

At Washington, D. C., only a few miles from the White House, the United States Government has established a bee-farm where, during every hour of the day and night, the activities of 3,750,000 of the finest Italian bees are watched and studied by a staff of experts.

No movement of the insects is left unobserved. By means of ingenious and extremely delicate apparatus the honey-gatherers are checked and tabulated as accurately as though the observer were living in the hive—perhaps more accurately, for an electric thermometer is oblivious to stings, while woe betide the unfortunate investigator — human or otherwise—who would personally invade the privacy of the bees' home!

This recent venture of the government is based on a desire to gather information concerning the possibilities of commercial development of bee-keeping in the United States. Not only are the life and habits of Nature's most marvelous insect under careful observation, but experiments are being tried in the crossing of breeds, the relative advantages of various types of hive, the qualities of the different honey and similar data that, when gathered and given to the public, undoubtedly will supply a strong stimulus to the somewhat neglected art of apiculture.

Among the many devices that the government bee-experts employ in their study of the hives, none is more remarkable than the bee weather bureau. Outside the experimental hives has been erected a complete weather station in miniature — anemometers, barometers, hydrometers, thermometers, and all the other "ometers" that go to make up the weather-man's armory. The reactions of the bees to the slightest change in meteorological conditions thus can be noted instantly.

The instruments have revealed that during the heat of the day—and Washington can be very hot during the day!—the bees are drowsy; that they freshen up with a cooling breeze; that during cold weather they huddle in clusters for mutual warmth, responding to the range of the thermometer just as do human beings.

ANOTHER strange fact brought out is that the bees are infallible weather prophets. The approach of a storm will send the most avaricious honey-gatherer winging for home in a bullet-like flight, to remain in the warmth and dryness of the hive until the bad weather has passed. Even though the coming tempest may not be noted by human senses, the bees, through some mysterious foreknowledge, are warned in ample time to take shelter.

Immensely valuable figures on honey-producing conditions are being tabulated through this system. The bees' responses to various weather changes enable the government experts to state with confidence which breed of bees is the best for any climate.

THE work of the bees is measured on a platform scale. The empty hive is placed on the platform and the scale balanced. A swarm of bees then is introduced and the weight read. After that the hive is weighed every day until it is full of honey. Since the number of bees in the original swarm is known, as is the daily gain in weight of the hive, the average daily honey-producing ability of a single bee is measured easily as the weight of the hive increases.

The work of the bees in the hive is observed by the introduction of magnify-

ing lenses in the sides of the structure. Electric lights are provided within the hive; the bees do not, apparently, object to this illumination. The lenses enable the observer to watch the bees at their work without disturbing them in the slightest.

BEES always have been known as wonder-working engineers. Their choice of the hexagonal cell and their construction of it is one of the mysteries of nature. The hexagonal cell with a base of three equal and similar parallelograms is the most economical cell that can be constructed with a given amount of material. What led the bees to choose it rather than the cylindrical shape, or the cube?

The most economical cell possible—the absolute in economy—has been found to have for its base angles 109 degrees 28 minutes, and 70 degrees 32 minutes. The mathematician König worked out these figures originally. When the angles at the base of the bees' cell were measured, it was found that they corresponded exactly to the figures of the human calculator! It would seem that the bees are by instinct as clever mathematicians as the most learned of men. And they build their combs in black darkness, a feat that the most skilled artisan among men might try vainly to match.

The clustering of the bees to produce the wax; the careful chewing and moistening process that must go on before the wax is fit for use; the actual construction of the comb itself by the worker bees—all these marvelous processes are observed at first hand, as well as the storing of the honey, the laying of eggs by the queen, and the emergence from the cells of the newly born bees.

No industrial or commercial enterprise ever launched by man has approached the efficiency of the busy hive. Though bees live only about seven months, their short lives are crowded with effort and achievement. Each bee has its own place in life, and its life work is appointed at birth. Moreover, whether it be honey-gatherer, sentinel, or comb-builder, the bee never attempts to change its occupation, nor to rise beyond its station. Greed, discontent, envy, and over-ambition are unknown in the hive.

We speak often of a "bee-line" to convey the meaning of the most direct course between two points. No bee-line that man might lay out, though, could be more direct than the path traversed by the bee between the flower and the hive. This is all the more remarkable since the bee does not steer its course by vision. The direct flight of the bird is understandable, since it readily picks up landmarks. The bee, though, cannot see for more than a few feet. Once it was believed that the bee guided itself by scent, but scientists know now that it does not smell its way back to the hive. They believe that its extraordinary acute sense of direction is due to its possession of an instinct unlike any possessed by man.

This homing instinct is one of the bee's strongest traits. If the hive is moved while the bee is out, upon returning it will dart immediately to the former location and wander about in a troubled way until it finds its home. If eggs are taken from one hive and hatched in another, the young bees will return to the original hive as soon as they are able to fly. There they will be welcomed, and welcomes ordinarily are not accorded to visiting bees.

If a strange bee visits a hive unladen, it will be attacked by the inhabitants. If it is carrying honey, though, it will not be disturbed, the bees seeming to know that a visitor with honey cannot be intent on harm.

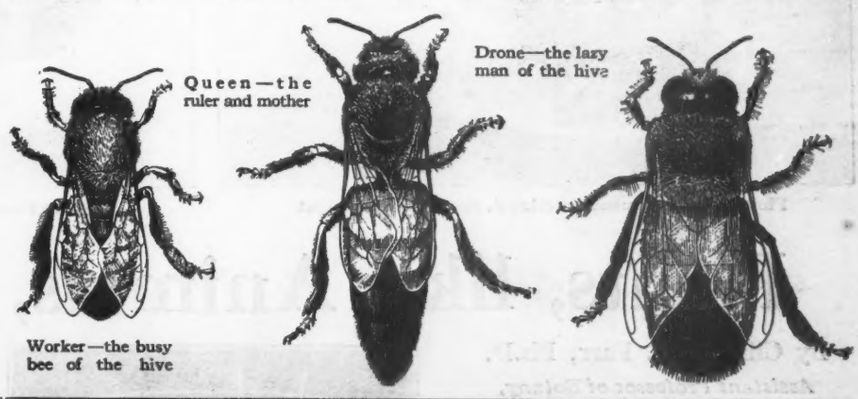
THE Washington observers have learned that the bee must rest after working. Having no eyelids, the bee cannot close its eyes in sleeping, but the worker bees are observed to retire to secluded cells in the comb at regular intervals, remaining there inactively for hours at a time.

A strange feature of life in the hive is a jazz dance that the bees stage every now and then. All the inmates of the hive take part, swaying to and fro and going through weird contortions. This, the federal investigators have come to believe, is merely the beehive system of communication. By their bodily motions the bees are telling one another where the choicest honey nectar is to be found and possibly choice bits of current gossip.

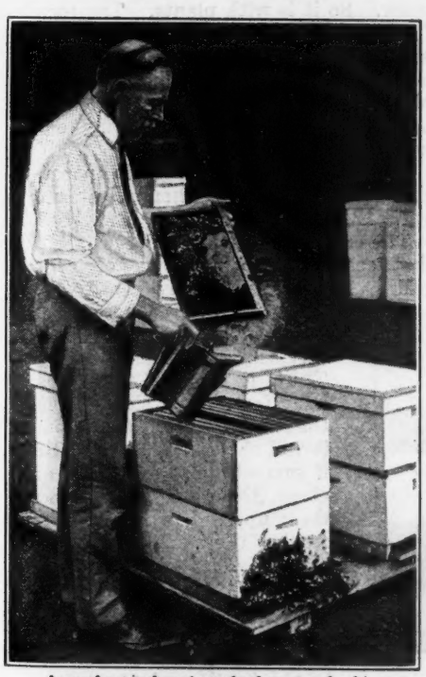
THE buzzing that comes from the bees as they work in the hives is not a song, nor is it made up of grunts denoting violent effort. It is the ventilation system of the hive at work. Bees apparently require fresh air as they labor, so they cause it to circulate by moving their wings in unison, bringing pure air in from the outside and driving the foul air out. The motion of the wings is responsible for the buzzing.

Sometimes mice and other small animals get into the hives. The sentinel bees immediately set on them and sting them to death. Obviously the carcasses of these intruders are too large for the bees

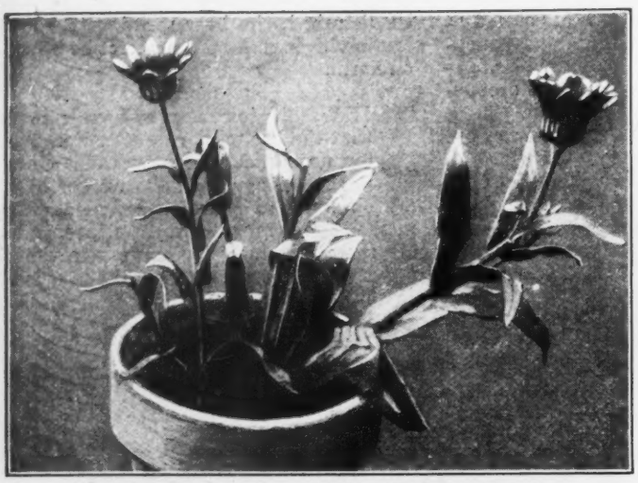
(*Continued on page 136*)



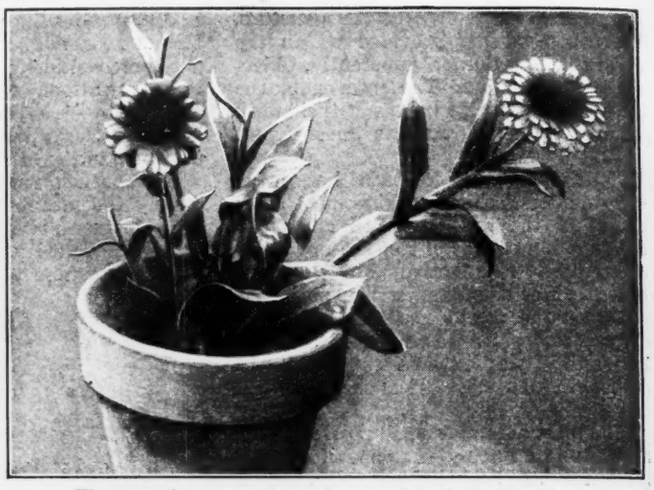
Through glass windows in the sides of the hive, as shown above, government scientists are able to observe the work of the bees day and night without disturbing them



A smoke torch quiets the bees as the hive is opened. Bees believe in preparedness. Sentries fly around the hive continually. At the approach of an invader the entire population responds instantly in battle array



Flowers of the common marigold, closing for the night



The same flowers, with petals opened to the light of day

Plants, like Animals, Feel Pain

By Clifford H. Farr, Ph.D.

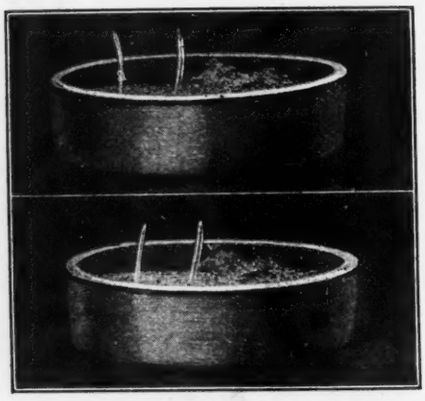
Assistant Professor of Botany, University of Iowa

IF YOU should see some one whip a horse or kick a dog, you would not question for a moment whether the animal felt the blow. But if you pluck a rose, peel a potato, or mow a lawn, you probably never stop to wonder whether the plants know that they have been touched, or whether they feel pain.

And yet recent developments in the study of plants point unmistakably to the likelihood that plants have a mental life, a consciousness, closely resembling that of man and the animals; that they have senses that record impressions, nerves for the transmission of impulses, centers of association where the nerve messages are distributed, and motor organs that respond to the messages.

In other words, plants apparently feel and see; suffer pain and experience other emotions. These conclusions have been reached by botanists as a result of observing the reaction of plants to various stimuli—the same process by which man has concluded that animals have senses and feelings and emotions.

The chief reason why man has been loathe to ascribe mental traits and feelings to plants lies apparently in the fact that most plants are so slow to respond to stimuli. The so-called sensitive plant, mimosa, is a striking exception. This plant will respond to a blow with amazing rapidity. If you strike the leaves of mimosa, the leaflets fold, and the leaf stalk droops quickly — evidence that the plant is highly sensitive. In the darkness the leaf stalk is raised and the leaflets are folded. Introduce light suddenly and the leaflets unfold in a way that suggests that the experience is unpleasant. Stroke the leaflets gently, though, and they will fold again as if the caress is pleasing. Then, if you strike the leaf sharply, the leaf stalk droops as if suffering pain.



Young oat seedlings before (top) and after (bottom) being exposed to a light from the right for 12 seconds. Note how they bend toward the light in this brief interval

THE mimosa actually is not more sensitive than other plants, but a special motor organ, called the "pulvinus," at the base of each leaflet and at the base of the main leaf stalk, causes the plant to move in response to stimuli it receives.

Plants are sensitive to virtually all the stimuli to which man responds, and in some cases to even a greater degree. The roots of certain plants will curve in response to an electric current that is 1/400 as powerful as the smallest current that man can feel. A pressure no stronger than the falling weight of a hair will be felt by some plants and will result in motion.

Plants respond to temperature, light, contact, shock, pressure, tension, gravity, electricity, wounding, gases, and liquids. In fact, the only sense that plants are known to lack is hearing. The ancients believed that certain plants responded to thunder, but modern botanists believe that this is a result of the jarring effect of the concussion.

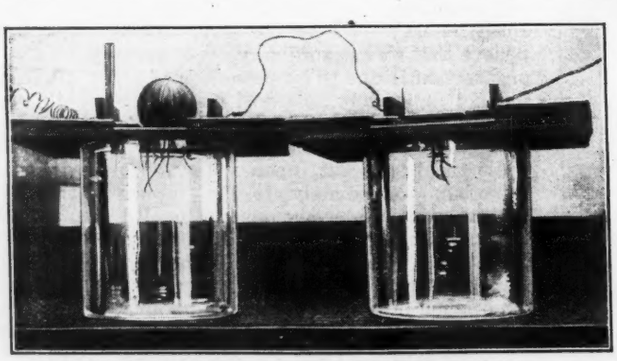
If plants cannot see, it is difficult to explain the fact that the compass plants turn the flat surfaces of their leaves toward the sun at all times of day—toward the east in the morning, the west in the evening and straight up at noon. The sunflower, too, turns to face the sun.

If you have been accustomed to work in the daytime, you would experience discomfort in suddenly engaging in night work. So it is with plants. The sorrel, for example, is almost obstinate when asked to change its habits. If this plant is placed in a room illuminated only at night, it takes it several days to learn to open and close its leaflets according to the new schedule of existence.

The marigold can be taught to open and close its leaves every six hours, instead of every 12, by subjecting it to artificial light.

The coleophile, the covering or sheath that envelops the seedlings of cereal grains, has proved highly sensitive to light. It even can add and subtract intervals of time in a way that is almost uncanny. Thus, if exposed to a weak light for a time shorter than that required for it to respond, it will show no reaction. But if several short exposures are given, the coleophile will add them up, and, when the total reaches the smallest exposure that will affect it, it will respond.

Sir J. C. Bose, the noted Hindu plant physiologist, discovered recently that plant cells have a pumping action similar to the beating of the human heart. He has found that plants contract and tremble under shock and respond to drugs.



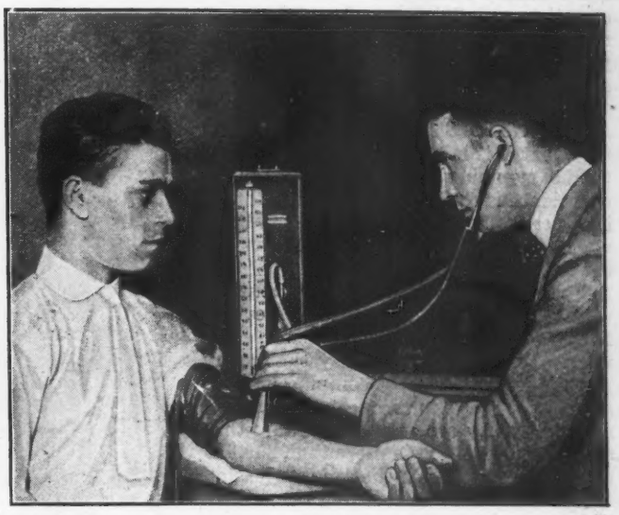
Shocking the roots of plants. An electric current of .025 milliampere is passing from right to left through water in the jars. The roots of the lupine plant in the jar at the right respond by curving toward the source of current, but those of the onion at the left apparently are not sensitive to this intensity, for they remain unmoved

"You Can Add 20 Years to Life"

Science, the Physical Auditor, Can Tell You Where to Find Them

The ear test—an important item in thorough health examination

Photos courtesy Life Extension Institute



Blood-pressure measurement is valuable in detection of disease

By James A. Tobey

Administrative Secretary of the National Health Council

HOW would you like to add 20 years to your life?

This may sound like an advertisement for a new kind of gland transplantation, but it is not. At the present time the average length of life among Americans is only 58 years, whereas it ought to be 78. Moreover, medical science knows exactly why those 20 years are missing and how you may find them and add them to your life.

Only a few weeks ago Dr. Ray Lyman Wilbur, president of the American Medical Association and of Leland Stanford University, asserted at a medical convention at Des Moines, Ia., that if doctors were permitted to apply all they know to all the people, not only would life be prolonged and human happiness increased, but the whole aspect and order of life would be altered.

What he meant was that people continue to die young because they fail to make full use of the knowledge and skill that medical science possesses, particularly in the field of preventive medicine.

People get a good start in life these days. Doctors have learned to bring them into the world in safety and to guard them against the diseases of infancy that once destroyed vast numbers of babies. Medical inspection in schools protects them against the diseases of childhood. But, once they are out of school and on their own, the subject of their health becomes overshadowed in importance by other things in their minds.

I received a postal card a few days ago from a friend of mine, a chemist, who for two years has been at Saranac Lake, N. Y., fighting tuberculosis. The message said he was cured and was preparing to start for home.

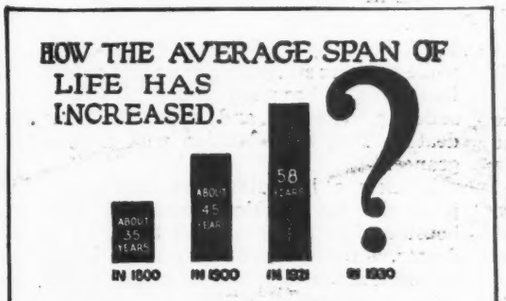
Naturally I was glad to receive that message, and yet I can't help but feel that quite unnecessarily that man has let two years slip from his life. He used to be fond of motoring, and was a crank about keeping his automobile in repair. The tiniest body squeak, the smallest rattle of the motor would send him scurrying off to a service station to have his car looked over. Yet that same man paid not the slightest attention to a cold that hung on and on. At last he was forced to quit his job and go to the woods to struggle for life.

A prominent breeder of fancy cattle died last fall from heart trouble. He was only a little past 40. An acquaintance of his supplied me with a few illuminating sidelights on this man. Many, many times, his friend told me, he had gone without sleep to nurse a sick cow. His cattle were housed in the most modern barns and their lives were regulated by the clock and scale. They were, in fact, better cared for than their owner; for he, suffering from a dangerous heart ailment for years, never had consulted a physician.

YET in spite of cases such as these, which probably are typical of the health carelessness of a majority of the population, modern medical science has succeeded in removing many of the obstacles to longevity. Especially is this true in the control of communicable diseases, such as malaria, diphtheria, tuberculosis, scarlet fever, typhoid, and a host of others.

Modern medicine is getting the best of them. Smallpox, which once was classed as a violent scourge, has pretty well subsided. Typhoid has almost disappeared, due to the activities of sanitary engineers in cleaning up municipal water supplies. Diphtheria is on the wane, thanks to the use of antitoxin and the Schick test. So it is with many other germ diseases. Tuberculosis has been reduced 50 per cent since 1900, and yellow fever has been eliminated in North America.

It happens, however, that there is another class of diseases, which science cannot control by such methods as supplying people with pure water to drink, or by eliminating germ carriers. Once these diseases have been permitted to develop, curing them is difficult and at times impossible. They are known as



IN A little less than a century and a quarter science has increased the average length of human life by more than 20 years. Since the sixteenth century the life span has been more than doubled. And in the last quarter century alone more than 10 years have been added.

Yet even now the annual economic loss to the United States from preventable diseases and deaths is estimated at $3,000,000. Every day 3,000,000 persons are sick in the most enlightened country in the world. This means that of every hundred Americans, nearly three are sick each 24 hours.

Experts in life extension tell us that from our present scientific knowledge, it is theoretically possible to prevent 250,000 deaths a year. They tell us, too, that the normal person, by careful living, can add from 10 to 20 years to his life. To do this, the first important step, they say, is a thorough physical examination by a competent physican at least once a year.

Will the year 1930 see the average number of our years increased to four score?

Science says it can be done, and shows us how to do it. It is up to us.

organic, or degenerative diseases, not communicable. They arise within individuals from physical reasons peculiar to the victim.

Included in this class are cancer, heart trouble, apoplexy, Bright's disease, and other kidney affections. Others medical scientists call "diseases of metabolism," such as diabetes, due to faulty chemical processes in the body. These are generally diseases of adult life after middle age.

DR. HARVEY WILEY once said that it is better to die of cancer at 80 than of typhoid at 20. But modern medical science is rather of the opinion that it is better not to die of either, but of old age, which happens to be the rarest cause of death today.

The worst feature of these degenerative diseases is that they frequently develop before one suspects their existence. Experience has shown definitely that many persons living perfectly complacent lives actually are suffering from some incipient malady. They are entirely unaware that anything is wrong. Of more than 250,000 persons examined by the Life Extension Institute since 1914, according to Dr. E. L. Fisk, its medical director, nearly all were found to have physical impairments.

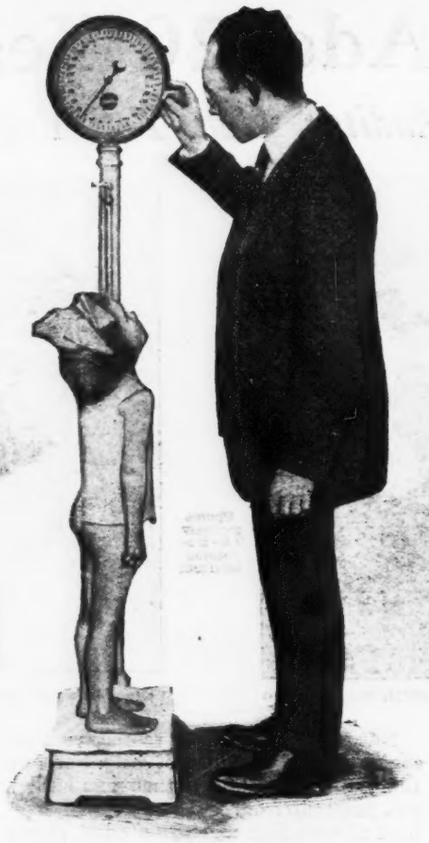
The secret of preventing the encroachment of organic diseases lies in early diagnosis. In other words, get to it at the start before the harm is done. This is more or less a new idea in preventive medicine. The old-time doctor would look at a patient aghast if he should walk into his office and say, "Doc, I'm feeling fine, but I want you to look me over thoroughly and tell me whether I am all right in every respect."

The doctor probably would reply with some agitation, "If you're all right, what are you here for?"

All that is changed nowadays. The modern physician considers it part of his duty to keep his patient well.

Samuel M. Vauclain, president of the Baldwin Locomotive Works, had the right idea when, as told recently in POPULAR SCIENCE MONTHLY, he arranged with his physician to keep him well or lose money by failing to do so. The best attorney is the one who keeps his client out of court and out of trouble. The same theory applies to a doctor. A good doctor is one who keeps his patient healthy and never has to cure him.

The first thing for any man who wants to add 20 years to his life is to start in a businesslike way to take a human inventory. Have the human machine thoroughly inspected by a competent physician. Most intelligent persons now have the laudable habit of going every six months or so to the dentist, whether they think anything is wrong with their teeth or not. The same practice can be applied profitably for the rest of the body. Physical inspection at least once a year will save doctor's bills. Expose your defects and disabilities while they are still young and more or less innocuous, and so ward off possible future suffering, trouble, and even an early death. This is prevention with a vengeance.



Periodic physical examinations of young children, as well as inspection in schools, have been important factors in the success of medical science in reducing mortality during the earliest and most dangerous years of life. In three decades at least 10 years have been added to the promise of life for children under five years of age

I knew a legislator who took great pride in his physical condition and boasted that he never had to go to a doctor. He worked unusually hard, attended many banquets, took practically no exercise and was afflicted with numerous worries.

One afternoon he saw an acquaintance at the top of a long flight of granite stairs in front of a public building. He particularly wanted to speak to this man on an important matter, so he rushed up the steps. When nearly at the top, he suddenly collapsed, and when bystanders reached him he was past assistance. The death certificate indicated as the cause, "acute cardiac dilatation," which translated into plain English, means heart disease.

This man had been living a placid life in ignorance of his dangerous malady. A physical examination would have revealed his condition and he would have been informed of the danger in such sudden exertion as running up steps.

I might go on and tell, perhaps, of the woman who scorned the lump on the breast, refusing to consult a competent physician, until finally a malignant cancer developed and the entire breast had to be removed to save her life. When you know that death is near, then is the time you usually want to fight to get back what you may have squandered. But the time to begin healthful living and practising the rules of hygiene is right now, not after you have had a physical breakdown.

IF ANY one wants proof that a periodic medical examination will add years of life, the most convincing evidence is right at hand. For a number of years a large life insurance company has offered to its policy holders free annual physical examinations. A study of the first 6000 persons examined in 1914 and 1915, revealed that only about half as many of these persons had died as should have died by every mathematical calculation based on long years of actuarial experience.

Whereas, by scientific computation, 412 of the 6000 individuals should have died, actually only 217 succumbed in five years. The officials of the company figured that by offering free physical examinations they had made, on a conservative estimate, at least 200 per cent on their investment.

If it is worth that much to a life insurance company to give its policy holders medical examinations, it is worth it to you to have one.

If every one in the United States would acquire the personal audit habit and have his physical assets checked up at least once a year, then eradicate any defects or ailments revealed by the audit, there is no question whatever that 20 years could be added to the average span of life.

Of course, merely getting an examination isn't the whole story. It is the follow up that counts. I may know that it is wrong to let a man sneeze in my face, but if I let him sneeze in my face, that is not safe living on my part. Here, then, is the hygienic recipe: Have a periodic human stocktaking.

Carrying the benefits of scientific health knowledge to out-of-the-way places. A traveling clinic visits rural districts, giving free examinations for children

Useful New Products from Rubber

Shipments of Milky Sap from Plantations May Revolutionize Industry

By Ismar Ginsberg, B.Sc.

NEW methods in rubber manufacture and the employment of rubber for many unusual uses are predicted as a result of the recent introduction on the market of rubber latex, the milk-like sap of the rubber tree.

This product is not new in the strict sense of the word, for it is the source of rubber as we have known it for many years. But never before has the latex been shipped. Whether gathered in the Ceylon plantations or in the jungles of South America, it always has been changed into crude rubber before shipment, by smoking over a fire of rubber leaves or by means of chemicals.

Now, though, the latex can be carried to the United States and elsewhere in tank steamships, as oil is, and transported to manufacturers in tank cars or drums. Thus, if they wish, manufacturers can utilize the latex in its original state in the manufacture of standard rubber articles without changing it into crude rubber.

The elimination of the crude rubber stage in the process of manufacture, of course, is of commercial importance. Even more important, though, is the possibility of using rubber in the manufacture of products in which rubber never before has been used. This is due to the fact that the latex can be handled almost as easily as water.

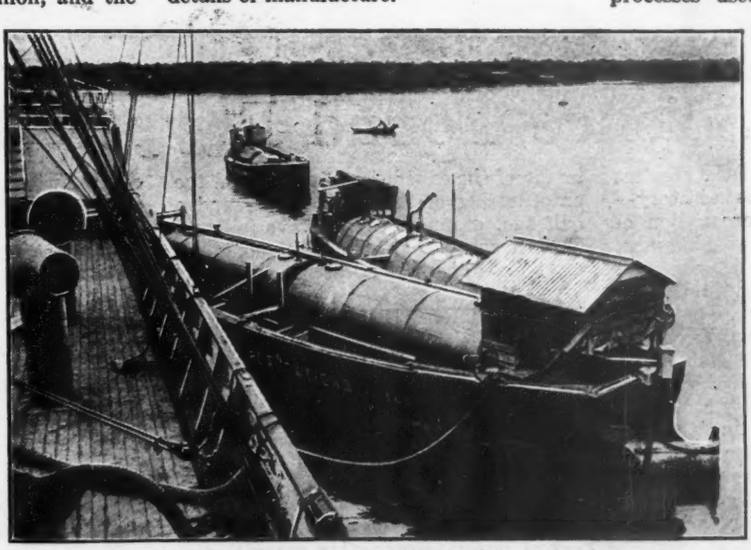
A native of Sumatra gathering latex, the milk-like rubber sap, for shipment

RUBBER latex is a milky fluid containing about one-third rubber. The rest is water and various resins. It is preserved with ammonia for shipment but, on exposure to air, the ammonia evaporates, and eventually the latex becomes a gummy mass. The latex can be mixed with almost any substance and it can be handled in such a way that the coagulation can be regulated to fit necessity. This is what makes it such a valuable product; for, after the rubber is coagulated, it holds together the fine particles of the mixture in a firm union, and the whole can be vulcanized and converted into a hard, strong mass in which the binder is solid rubber.

The advantage of using rubber latex is demonstrated, experts say, in the tire industry. Better impregnation of the tire fabric is obtained by dipping it into the latex, they declare, than by compressing the fabric and crude rubber between rollers or saturating the fabric with a solution of crude rubber. Waterproof fabrics of all kinds are said to be improved and manufactured at less cost by using the liquid product.

In the fields of industry where rubber never before has been used, the new product has aroused the greatest interest. For example, until now there has been no putty that will hold a window-pane in place permanently. When putty is dry, it always falls out of the frame. Tap an old window-pane and you are likely to dislodge both the putty and the glass. But a putty made from rubber latex and a suitable pigment or filler is said to last as long as the pane it holds. That is because rubber obviously is more lasting than linseed oil, which, with a filler, now composes putty.

Similarly, in the manufacture of linoleum and oilcloth, rubber latex offers an improved substitute for linseed oil, requiring no extensive changes in the details of manufacture.



Two of the river tankers that carry Sumatra latex to the wharves in the Dutch East Indies, where it is loaded on ocean freighters

In the manufacture of a waterproof cement, or paint, to seal against moisture cellar walls, floors, or similar porous structures, the possibilities of rubber latex are apparent. Already it has been used experimentally in making cements. This process is simple, requiring only that rubber latex be mixed with the desired adhesive.

Rubber cement is ready for use at any time, does not have to be heated, and is absolutely waterproof. Besides lending itself to such uses as the repair of automobile tires, it can be employed even to join glass and metal. Likewise it has proved a satisfactory binding agent for such woods as ebony that usually must be treated with chemicals before they can be glued. Glass, mica, paper, leather, and textiles of many sorts can be glued firmly by cements made with rubber latex.

EVEN when mixed with such substances as waterglass or glue solutions to produce cheaper cements, rubber latex produces a waterproof joint, provided, of course, that it is not diluted too much. These cheaper cements can be used in the manufacture of furniture for joining wood and glass, wood and brass and fastening brushes into wooden and metallic handles, in the manufacture of furniture—for virtually every purpose, in short, for which glues are used.

Hemp moistened with rubber latex can be used in making pipe joints. Glues made with rubber latex are said to be especially adaptable to the manufacture of violins and similar stringed musical instruments. In violins it is said to produce tones that compare favorably with those of the instruments made by old Italian masters.

Finally, for the rubber industry in general, the shipping of latex from the plantations makes possible the manufacture of crude rubber by new scientific methods rather than by the primitive processes used by the natives. Thus, instead of men stirring the latex by paddles, it now flows on a whirling horizontal disk, which sprays the fluid in a mushroom-shaped mist into a heated current of air. Drops of rubber fall into a container where a white, spongy mass is formed.

Crude rubber made by this process is said to be of uniform quality, especially useful for the manufacture of tires, tubes, rubber soles and heels and similar rubber goods. Crude rubber has been produced successfully by this process in a factory near New York and the general adoption of the process is expected to lead to results little short of revolutionary.

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Where Science Found Egypt's Treasure

THE dramatic climax of the greatest archeological romance in history—the discovery and excavation of the treasure-laden tomb of Tutankhamen, king of the eighteenth Egyptian dynasty, 3200 years ago—is pictured in the remarkable photograph above.

Howard Carter, American Egyptologist, who in December, 1922, found the ancient vault in the Valley of the Kings, is shown kneeling on the dusty rock floor of the burial chamber, opening the last door of the innermost shrine. At this instant was revealed the priceless goal of a ten-year search—the great golden-pink granite sarcophagus that has held the mummified remains of the great king.

Since Carter and Lord Carnarvon, leader of the expedition, first entered the antechamber of the tomb a year and a half ago, dramatic events have followed in quick succession. Tragedy, too, in the mysterious death of Lord Carnarvon.

TUTANKHAMEN'S tomb proved to be the richest find in history. Its outer chambers gave up riches beyond price—gold, precious jewels, alabaster. And, beyond all, ancient inscriptions and decorations that are rewriting history.

Proceeding slowly, Carter and his men recently reached the gilded outer shrine that almost filled the sepulchral chamber. Within were three other shrines, like a nest of boxes, covering the sarcophagus. Here were found the royal throne covered with beaten gold, the royal mace, alabaster vases, perfumes, and the ebony beds of the king and queen, inlaid with precious stones.

On the doors of the fourth and last shrine were carved two goddesses with protecting wings outstretched, indicating that within lay the coffin of the king.

A FEW days later, Carter, using intricate tackle, lifted the sarcophagus lid. Two linen shrouds were rolled back, revealing a huge golden mummy case, its top fashioned in a strikingly lifelike semblance of the dead king, one hand holding a crooked scepter of gold.

The Egyptian government now has assumed control of the treasure-filled tomb.

Power in the Volcano's Hot Breath

By William J. White, Jr.

VOLCANOES, which since earliest times have been a symbol of disaster and terror, today are known to scientists and engineers as a source of productive use to man in exactly the same way as are the waterfalls, coal-mines, and oilfields. Science has learned that volcanoes may be tamed and harnessed to work patiently and steadily in the production of power to turn the wheels of industry and to supply man with light and heat for his home and work.

A striking instance of the application of this new knowledge is furnished in South America, where engineers are preparing to subjugate the great volcano Tatio, member of the mountain chain known as the Cordillera Silillica, between Chile and Bolivia, by methods that might be compared with those used in prosecuting a water-power development or any other great industrial project.

They plan to convert into electric power the energy developed by the boiling lakes of lava in Tatio's mighty depths and to utilize it to conquer the mountains by electric railways and so to promote the industrial and commercial development of Chile and Bolivia.

A coal shortage that left these two countries in a desperate plight was the direct cause of the project to harness Tatio. A geological party, seeking oil along the Chilean-Bolivian frontier to supplant the dwindling coal supply, noticed a huge cloud that clung to the side of the slumbering volcano. Investigating, the scientists discovered that the phenomenon was caused by great clouds of steam puffing through cracks in the mountain sides.

The geologists took no action at the time. But not long ago, word reached South America that an electric plant in Italy was being run successfully by volcanic steam and the engineers who were responsible were invited to visit Tatio.

The visitors were amazed. With the proper machinery, they asserted, the steam emanating from Tatio's slopes could be converted into electric energy totaling 400,000,000 kilowatt hours a year—the equivalent of almost a half million tons of coal! The steam was found to be virtually free from impurities, which would permit it to be run directly into turbines without the necessity of installing expensive and complicated cleansing apparatus.

WHILE the harnessing of Tatio has not progressed beyond the planning stage, a company has been organized to carry on the project. Electric railways, one of which already has been established from Santiago to Valparaiso in Chile, are the most likely possible consumers of electric power. Then there are the silver and copper mines in southeast Bolivia and northeast Chile.

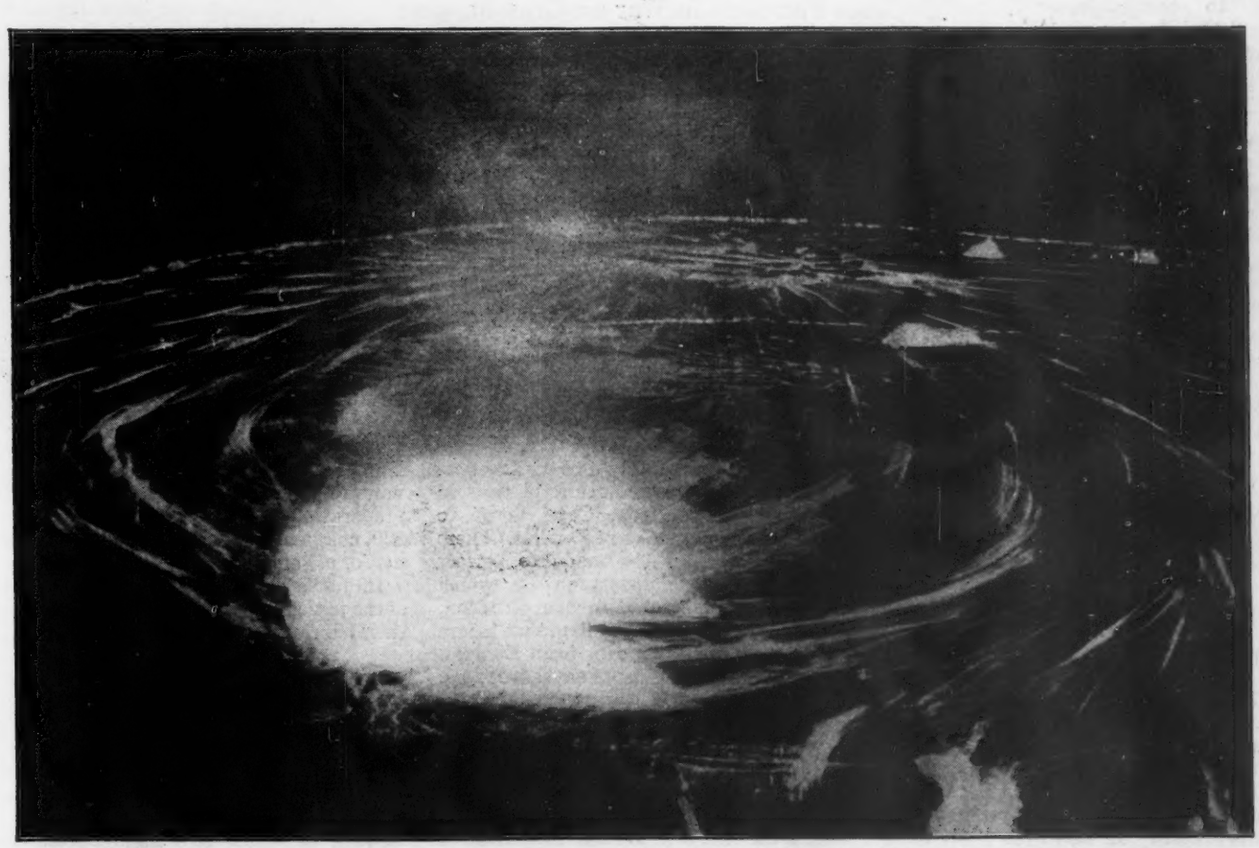
South American engineers say that the construction of a volcano-driven electric plant on Tatio's sides undoubtedly will result in immediate commercial development of both countries.

As a demonstration of the immediate practical commercial utility of harnessing volcanic power, the achievement of engineers in the Volterra region, in Italy—about 50 miles south-southwest of Florence—is most significant. From the generators, electric power is being carried half a hundred miles and more into Florence, Leghorn, Sienna, and Piombino.

THE Volterra region contains about 2½ square miles of volcanic land in which steam jets and hot-water springs abound. Iron-incased bore-holes, from 200 to 500 feet deep and 16 inches in diameter, have been made here at advantageous locations, and from them the natural steam issues at high pressure and at a temperature ranging from 200 to almost 400 degrees Fahrenheit. The steam is piped to suitable turbines, connected directly with electric generators.

Bending the volcano to the needs of industry marks a tremendous step forward in man's struggle to tame the forces of nature. And yet, in the opinion of leading engineers, the future holds a much more thrilling prospect. Some day, they believe, man will make his own volcanoes by boring miles into the ground to extract and utilize the heat of the earth's interior.

Sir Charles Parsons, responsible for the steam turbine, already has estmated that a shaft sunk 12 miles into the earth's crust would tap the earth's store of internal heat. Some day it must be tried. For the ever-increasing demands that are being made on the earth's coal and oil eventually will lead to their exhaustion, and, when these sources of power fail, what substitute more logical than the millions of horsepower that slumber under earth's rocky crust?



A spectacular nighttime photograph of a volcano's crater, where boiling lava and steam hold tremendous stores of unused power

Pathfinders in Science

A Close-Up of Mars—Thought by Radio—The Sky—New Discoveries

IN AUGUST of this year, we shall be within 35,000,000 miles of Mars—merely a three-minute hop for a radio or light wave.

Scientists who know more about the geography of this neighboring planet than was known about the surface of the earth only a few hundred years ago, will be on the lookout for new facts when the visitor comes closest this summer. Particular efforts will be made to ascertain, if possible, whether there is life on Mars.

If Martians exist, scientists say that they probably are not like us. Astronomical study has shown that conditions on the neighboring planet are not like conditions on earth; hence, not of a sort to support the life we know. That does not mean, though, that Mars cannot support any kind of life, any more than the fact that man cannot live at the bottom of the ocean proves that there cannot be fish.

If there are intelligent beings on Mars, no matter what their size and shape, scientists of the earth some day will learn how to communicate with them by exchanging some sort of signals.

Once the inhabitants of either planet are certain that the other also is inhabited, some sort of an interplanetary code may be developed, and an exchange of ideas and opinions may be possible. The Martians even may tell us how to conserve the energy of the sun.

A suggestion like this, coming from a present-day scientist, is scarcely more fanciful than would have been the suggestion a hundred years ago that men on opposite sides of the earth some day might communicate with one another by radio.

Can Thought Be Wirelessed?

RADIO was used recently by three eminent psychologists in an attempt to transmit thought. Prof. Robert H. Gault of Northwestern University, Prof. Gardner Murphy of Columbia University, and Prof. H. B. English of Antioch College, who conducted the experiment, asked radio listeners to concentrate and try to interpret unspoken thoughts.

They reported answers received from listeners who took the test indicated that thought had been transmitted hundreds of miles without the aid of words or code.

The transmission of thought would seem to be the next big forward step in metapsychosis. It may even prove to be the means of communication with Mars.

A New Blue Sky Theory

PROFESSOR VEGARD, of the University of Christiania, Norway, has advanced a new theory to account for the blueness of the sky. Just outside of the earth's atmosphere, he says, is a wall of crystalline particles of nitrogen, incasing the earth in the same manner that a fabric envelope incases a balloon or a dirigible.

Uses Parasites in War on Grasshoppers

N. A. Cobb, agricultural technologist of the Bureau of Plant Industry, Department of Agriculture, has made remarkable progress in recent months in efforts to free the American farmer from the ravages of the grasshopper, one of the most damaging of agricultural pests. In numerous laboratory tests he has found that a certain parasite, called "mermithid," is one of the deadliest enemies of the insect pest. Artificially infested grasshoppers containing six or eight mermithids die in about eight days, he reports, while it is doubtful if grasshoppers harboring more than one of the parasites ever reach maturity. The parasites multiply with amazing rapidity

Besides giving the sky its blue color, these particles account for several other phenomena, he says, including the fact that radio waves follow the contour of the earth instead of flying from it at a tangent.

Directed Radio for 2200 Miles

GUGLIELMO MARCONI at present is experimenting on directed radio communication over a distance of 5000 miles, from England to South America. Already he has made successful tests in sending messages from Cape Verde to Cornwall, a distance of 2200 miles. These experiments are being made to perfect his method of transmission by which energy is concentrated in one direction. Thus, for instance, he predicts that before long messages can be sent from England to Canada without fear of eavesdroppers.

Novel Methods of Propulsion

AMAZING new methods of propelling vehicles over land and through the air have been reported from Europe within the last few weeks. M. Melat, a French inventor, is said to have developed an airplane that lacks a propeller and a conventional motor, yet is capable of a speed of 400 miles an hour.

This machine is literally hurled along in flight by explosions. Air and compressed gas are exploded in a combustion chamber and permitted to escape through a series of valves. The contact of the escaping gases with the air pushes the machine ahead. This method is similar to the one by which Prof. R. H. Goddard, of Clark University, hopes to send his rocket to the moon, as described in the April issue of POPULAR SCIENCE MONTHLY.

Another French inventor, M. Imbert, has evolved an automobile run by charcoal gas. This gas is produced in a furnace carried in the rear of the car, and is fed into an ordinary gasoline motor. Tests are said to have been entirely successful.

Meanwhile Fausto Zarlatti, an Italian engineer, has aroused the interest of railway officials in his country with his scheme for driving locomotives by compressed air. The compressor is carried on the tender, and is operated by low grade fuel oil. The compressed air is piped to the boiler, then pumped into the cylinders. This scheme, it is said, would effect a tremendous saving.

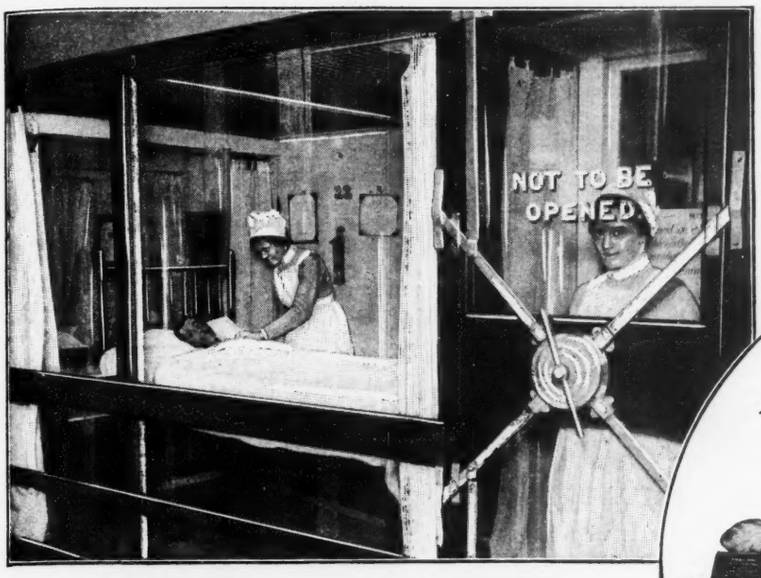
A Remedy for Blood Poison

DR. HUGH YOUNG, director of the James Buchanan Brady Institute at Johns Hopkins University, recently announced the development of a remedy for blood poisoning, said to have proved successful in the treatment of several patients who were at the point of death. The treatment, which was developed by Doctor Young and Miss Justine Hill, involves the injection into the veins of a preparation known as mercurochrome-220, composed of mercury and a dye product, or of gentian violet, a well known dye.

Immediately after treatment the body of the patient assumes the color of the dye; then his rapid recovery begins.

The Ma Jong Itch

IF YOU play ma jong, you may be exposed to the newest disease "ma jong itch." It resembles ivy poisoning, and is contracted, physicians say, from touching the boxes and trays, finished with a lacquer, in which is a highly poisonous extract of a plant called *Rhus vernix*.



An Oxygen Treatment for Bronchitis

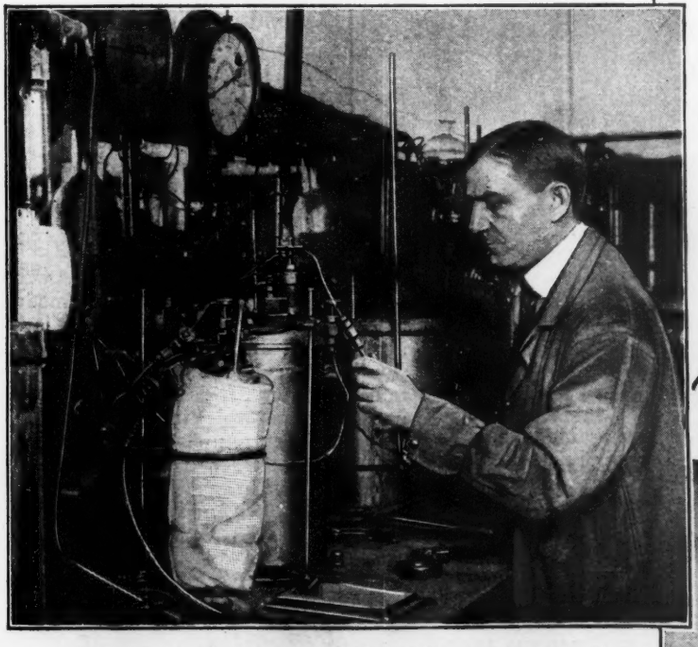
To test the life-saving and pain-relieving powers of oxygen in the treatment of respiratory diseases, particularly bronchitis, experiments with a hermetically sealed glass bedroom containing oxygen are being conducted in Guy's Hospital, London, England. In this sealed room patients are kept for five days in an atmosphere containing from 40 to 50 per cent of oxygen, or double the amount present in ordinary air.

The patients are reported to have experienced relief from the acute and painful stages of their illness, and to have shown improvement for several days after the treatment.

The oxygen sickroom shown above is the invention of Dr. E. P. Poulton, London physician. At the right a nurse is seen fastening the gastight door on entering.

Eggs 40 Million Years Old

Prof. H. W. Nichols, assistant curator of geology at the Field Museum, Chicago, is shown below exhibiting fossil eggs believed to be 40,000,000 years old, found in the "bad lands" of South Dakota and recently received by the museum. They have been identified as eggs laid by a prehistoric bird similar to the duck, and are believed to be among the oldest traces of animal life yet found.

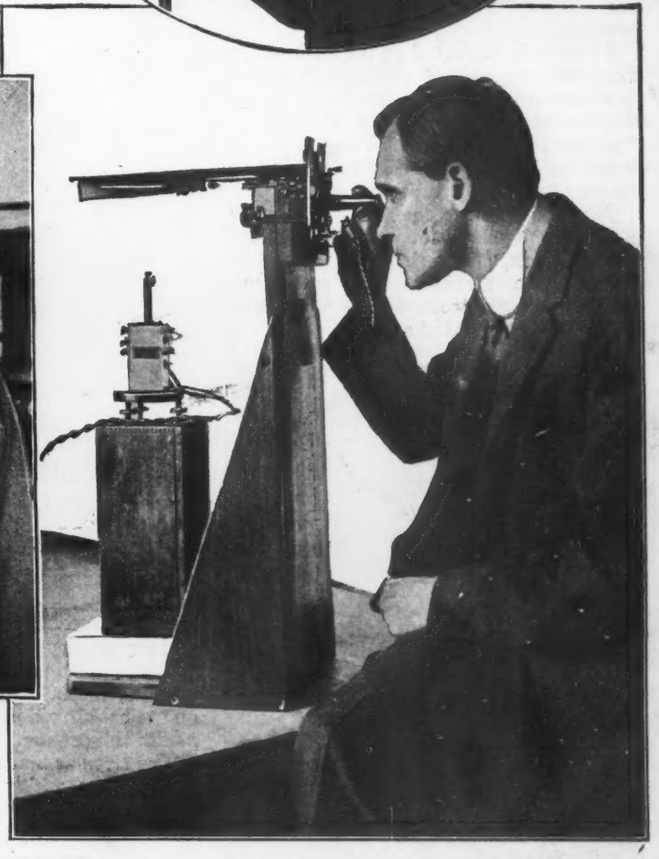


New Explosive and Fertilizer Found

Cheaper ammonia, cheaper nitrogen fertilizer, and therefore cheaper food are promised in the announcement of the discovery of a new chemical process for permanently uniting hydrogen and nitrogen atoms in the air to yield 14 per cent ammonia. The new process was perfected at the Fixed Nitrogen Research Laboratory of the United States Department of Agriculture, Washington, D. C., under the direction of Dr. Alfred T. Larson.

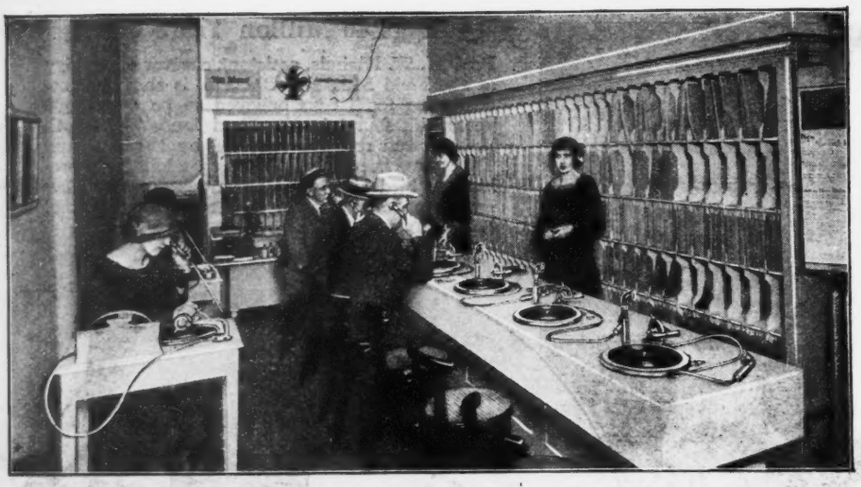
He is shown above in his laboratory experimenting with the new uniting chemical, or "catalyst," composed of iron oxid, aluminum oxid, and potassium oxid.

Not only will the discovery supply much-needed cheap fertilizer for American farms, it is said, but it will supply the United States government with an explosive twice as effective as that discovered by the Germans just before the world war.



Measures Heat of the Distant Stars

Accurate measurement of the heat of the most distant stars in the heavens has been achieved by Dr. W. W. Coblentz, of the United States Bureau of Standards, who is shown above with the measuring instrument he has perfected. This instrument is so delicate that it is responsive to the heat of a candle 50 miles away. It transforms the heat of starlight into electric current measured in 10 billionths of an ampere. Star heat was found to vary from 3000 to 10,000 degrees.



Music Shops Adopt "Noiseless" Phonographs

ALTHOUGH designed primarily to end confusion of sound in phonograph-record shops, a newly invented "silent" talking machine may be useful also in apartment houses. With it, one can listen to a record without a sound being heard by any one else who happens to be in the room.

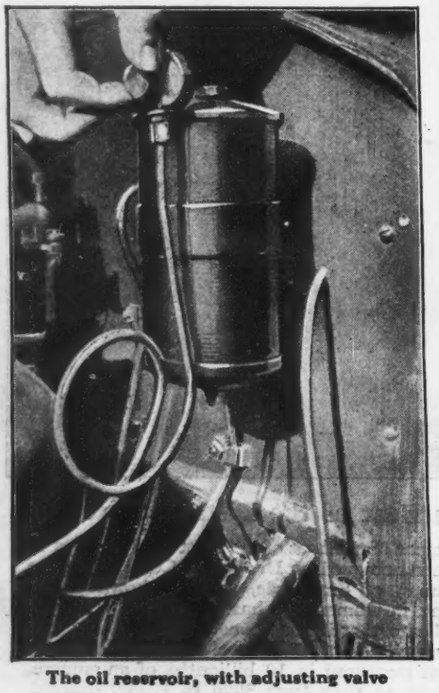
A wire cord leads from a small box at the base of the reproducing arm to an earphone, which is said to reproduce the sounds clearly and accurately.

Automatic Lubrication for Engine Cylinders

TO MEET the need for adequate lubrication of auto engine cylinders an automatic device that gives the chambers a steady, fresh supply of oil has been invented.

A reservoir, mounted on the dash under the hood, supplies the oil through a tube to a central insert in the intake manifold, between the carburetor and the engine. The pumping action of the engine introduces the oil, the quantity increasing as the speed of the motor increases.

The oil enters the combustion chamber in a vaporous condition, bathing cylinder walls, pistons, piston rings, and valves at each intake stroke. The maximum amount to be introduced may be regulated by adjustment of a valve.



The oil reservoir, with adjusting valve

Revolving Wood Trimmer Operated by Hand

THE swiftly revolving blade of this new hand trimmer will not crush nor tear the toughest wood, it is claimed, but will leave a perfectly straight and smooth edge.

The total cutting edge is 16½ inches, and any angle up to 45 degrees may be cut by setting guides on the machine. The 45-, 60-, and 90-degree angles are marked on the base to aid the workman and to expedite this setting.

The circular blade is used to produce a shearing cut, and is revolved by pulling a hand lever, which acts on the blade through gearing.

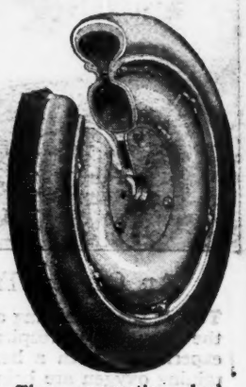
Glue Made from Garlic

A NEW raw material for the manufacture of a strong adhesive is reported to have been discovered in garlic, which when subjected to a boiling and pressing process yields a sticky substance of strong binding power.

Pneumatic Auto Wheel Absorbs Road Shocks

LONGER tire life, greater buoyancy, and greater carrying capacity are claimed for a remarkable pneumatic automobile wheel developed in England. These advantages are embodied in a "double tire" arrangement by which an over-sized inner tube is permitted to extend into a chamber on the under side of the rim. This feature makes it possible to use a nine-inch inner tube with a 3½-inch cover.

The wheel is divided into perpendicular halves, their outer edges designed to accommodate the bead of a standard cover. Between these outer edges and flat central portion next to the hub the halves form a second tube space with a volume considerably greater than that found in the ordinary inner tube.



The pneumatic wheel, showing inner air chamber

Six small sleeves are vulcanized in the inner tubes at six equidistant points. Through these pass the bolts that hold the halves of the wheel together. The halves are separated by a bit more than an inch.

The greatly increased air capacity obviously augments the shock absorption of the wheel. The enormous air capacity of the tire permits use of an inner tube with walls so thick as greatly to reduce the risk of punctures and blowouts.

A Sanitary Wash-Basin for All Hands

A COMPACT and sanitary wash-basin, designed to accommodate three or four persons at one time, is the invention of Louis Schlesinger, of Milwaukee, Wis. The water is delivered in a radiating shower from a central fountain, upon the top of which is a liquid soap container with four outlets.

Three wash up at the fountain basin

New Plumb-Bob Designed for Quick Adjustment

MORE useful in many ways than the ordinary plumb-bob is a new instrument that permits instantaneous adjustment of the length of the cord by which it is suspended. This adjustment is accomplished by a slight turn of a milled cap, releasing or tightening a clamp that holds the cord. When the clamp is released, a reel and springs within unwind or lift the bob.

A braided linen cord suspends the device from the hand or from a tripod head, obviating the annoyance of broken, tangled, or knotted cords. A hole in the hard steel point permits its easy removal for protection when not in use.

The new plumb-bob, showing adjustment cap

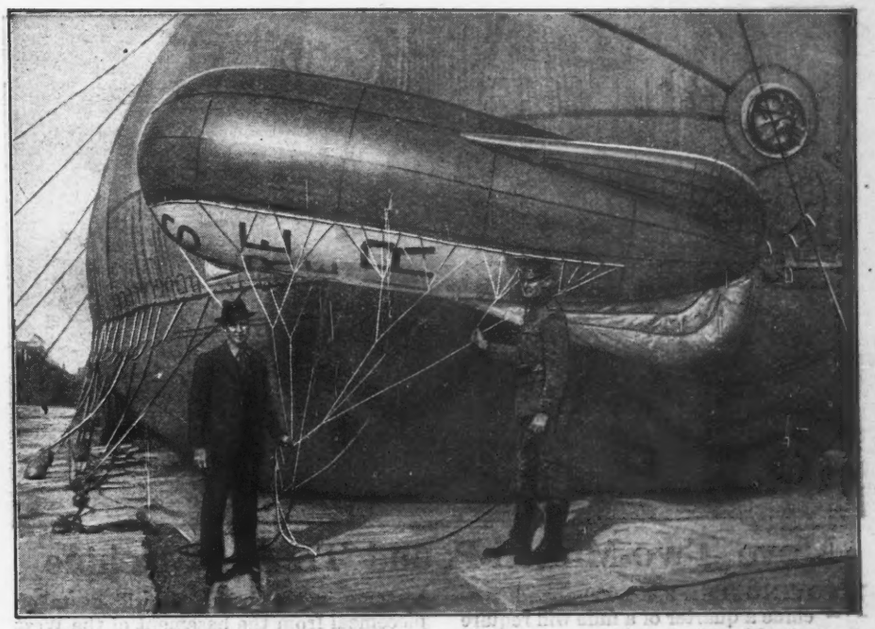
The bob is designed particularly for use in surveying work that requires many set-ups. These consume a great deal of the surveyor's time when the usual long adjustments are required. In any sort of construction work, too, the new device is said to be a valuable saver of time.

One-Foot Control for Ford Brake and Clutch

A ONE-LEGGED man can drive a Ford car as well as his two-legged brother, it is claimed, with a new clutch control attached to the brake pedal. It consists of a curved piece of metal that presses against the clutch pedal when the brake is applied. Thus the clutch is placed in neutral whenever the driver wishes to stop.

The invention will be welcomed by all Ford drivers, for it frequently happens that a driver presses his clutch pedal too far, thus throwing the clutch in low at the same time that he applies the brakes. The result, very naturally, is excessive wear on the brake bands.

Control bar attachment for brake pedal



The World's Smallest Observation Balloon

ONLY 14 feet long, the world's tiniest observation balloon is said actually to carry an observer aloft in perfect safety and to a considerable altitude. It is shown above dwarfed by comparison with an ordinary army air service dirigible.

This midget flying bag is the invention of A. Roy Knabenshue, of Los Angeles, the man shown in civilian clothes.

Standing Crops Measured by Auto Meters

USING automobiles equipped with a specially designed meter upon which is automatically registered the size of crops standing in fields passed, the United States Board of Crop Estimates hopes to obtain greater accuracy than ever before in crop reports.

The device is really a combination of 13 speedometers in one. There is a meter for each crop, such as wheat, corn, oats, cotton, and hay. The instrument is operated from the speedometer gearing of the car. There are 12 crop meters and a speedometer that registers the total mileage.

Each crop meter, controlled by a button plugged in by the operator, records in linear feet the measurement of the field being passed.

At the beginning of a wheat field, for example, the wheat button is thrown in. At the next field, another button is thrown in, causing the wheat meter to stop registering.

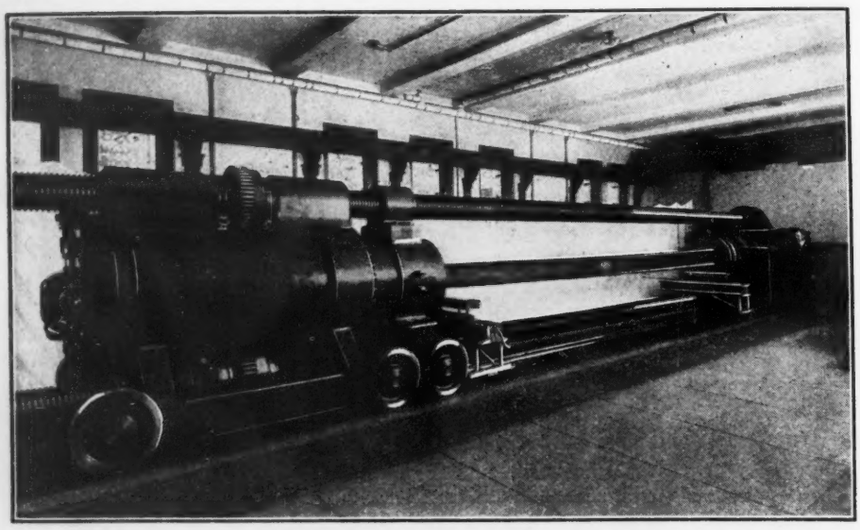
The totals for all fields should check with the total speedometer mileage.

Removable Window Sashes to Lighten Housework

OPENING the windows for ventilation without creating unhealthful drafts and without permitting rain to enter, is said to have become possible by means of newly invented removable window sashes. Both sashes not only slide up and down but also open inward at the top.

Since both sashes can be removed quickly and with little effort, the work of washing windows is made safer and easier. This feature also makes it possible to convert a bedroom virtually into a sleeping-porch, with a minimum of trouble to the occupant.

Removing the sash to wash the window



Move Two-Million-Pound Testing Machine

MOVING this 2,300,000-pound machine a quarter of a mile will require about three months' work by the United States Bureau of Standards at Washington, D. C.

The machine, one for testing structural steel beams, is said to be the most cumbersome in the world. It will be taken piecemeal from the basement of the West Building to the Industrial Building, a half dozen men doing the work.

The huge front cylinder of the machine, weighing 22 tons, presents the most impressive task. It will have to be elevated tediously to a height sufficient to place it upon an especially constructed trailer, hauled by a powerful truck.

IN AN unsuccessful attempt to solidify helium, Prof. Kamerlingh Onnes, of the University of Leyden, Holland, attained the nearest recorded approach to the absolute zero—about 458° F. below zero.

Machine Embosses without Heat, Glue, or Ink

EFFECTIVE embossing can be accomplished by any person, it is claimed, with this recently patented machine, which requires no heat, ink, or glue and is said to have no complicated parts.

Loose type is placed upon the type bars and a piece of cardboard, together with a specially prepared paper, is inserted. A long lever is pushed down, accomplishing the embossing. By using colored paper, colored printing will appear embossed on the card.

A 5000-Mile Stage Line

JOURNEYING from coast to coast by motor stage soon may be possible if plans for a 5000-mile stage line from New York City to Los Angeles, Calif., and up the Pacific Coast to Portland, Ore., are carried to completion. The trip, lasting 25 nights and 26 days, would be made in luxurious touring coaches carrying eight passengers beside the driver.

The cost of the trip, exclusive of meals and lodging *en route*, would be $175.

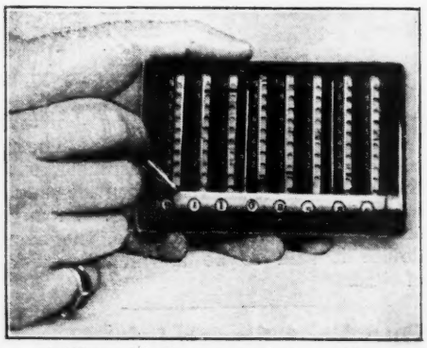
A Pocket Adding Machine for Quick Accounting

A POCKET accounting machine of recent invention can be used, it is claimed, to add, subtract, or multiply.

The device holds eight columns of numbers from 1 to 9. Opposite each column is a movable metal band that runs continuously over rollers. Each band has perforations that fall opposite the numbers in the columns.

Addition is accomplished by inserting a wooden pointer or pencil in the band perforation opposite the desired number, and pulling the band downward until the pointer reaches the bottom of the column. Addition of two numbers in this manner causes a red signal to appear in the totals row at the bottom. When this signal is pulled down, the total is registered automatically.

Since the machine has eight columns, its capacity is $999,999.99.

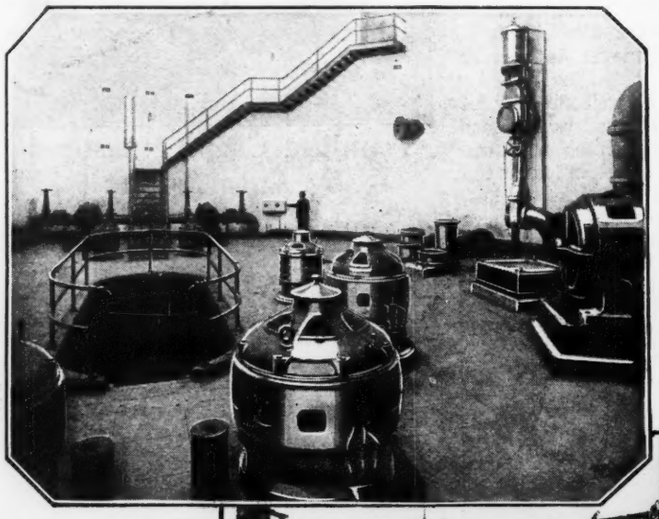


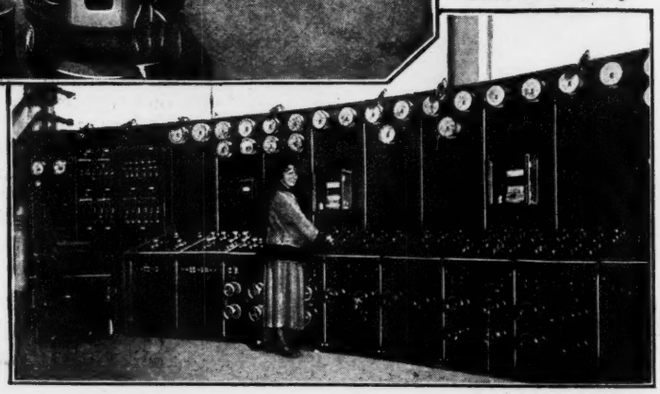
Adding with the new pocket machine

Woman Operates Mammoth Filtration Plant

ONE young woman, at an electric control board recently operated for several hours a new $3,000,000 filtration plant constructed to supply 48,000,000 gallons of pure water daily to Sacramento, Calif. It is claimed that she, or any other one person, could operate the plant continuously unassisted, so simplified are the controls of the plant's extensive mechanism.

Miss Althea Farriss, of Sacramento, is the young woman who operated the plant following its dedication by President Coolidge, who set its machinery ahum by touching a button 3000 miles away.





Above: The operating floor of the new $3,000,000 filtration plant for the Sacramento, Calif., water system, showing electric motors. At the right: Miss Althea Farriss, Sacramento stenographer, at the control board

Electric Motor Sharpens Lawnmowers Quickly

ANY make of lawnmower can be sharpened quickly and thoroughly, it is claimed, in a simple new mechanical sharpener driven by a one-quarter-horsepower electric motor. It is necessary only to remove one wheel of the mower and to fit in its place a clutch pulley, which turns the blades while they are being sharpened.

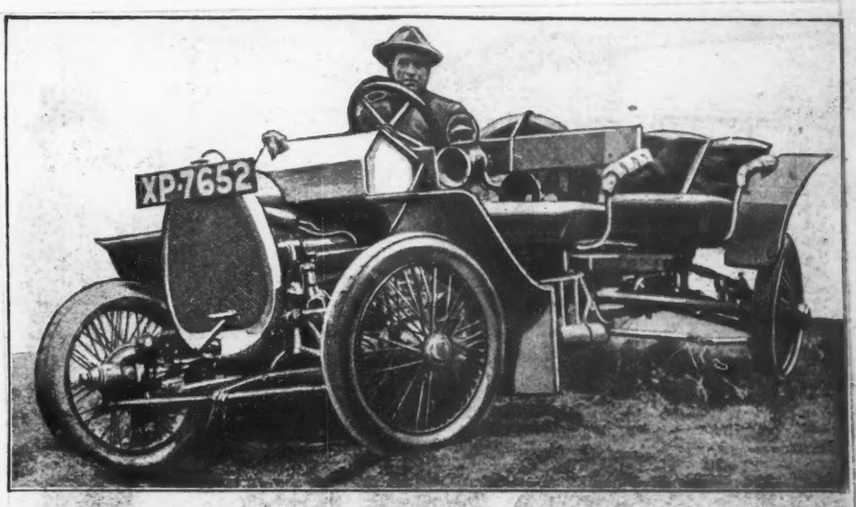
The manner in which the blades and cutter bar are sharpened together might be likened to the method employed in grinding in valves in a gasoline engine. Powdered emery dust or carborundum is placed on a piece of thin cardboard about

A motor revolves the lawnmower blades

10 inches wide and a paste is formed by the use of a little machine oil.

The revolving blades are allowed to draw in the compound by passing the cardboard from left to right. This compound on the cutter blades as they meet the cutter bar serves to sharpen both at the same time.

This process makes it unnecessary to remove the roller, cutter bar, or handle of the mower in order to sharpen the blades.



Four Wheels for Drive, Brake, and Steering

EACH of the four wheels of this unique and powerful British car has a direct part in driving, braking, and steering. The results claimed from this system are greater power, safety, and mobility.

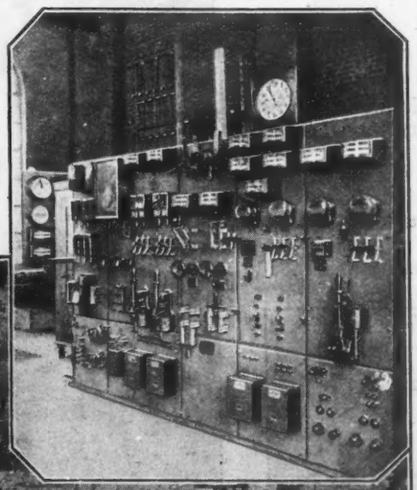
Through the four-wheel steering system, the car can turn, it is said, in its own length. The four-wheel drive mechanism enables it to climb the steepest hills with ease, its makers assert.

This Turbine Power Plant Runs Automatically

OPERATING without human control, halting while minor difficulties are adjusted, and stopping altogether if something goes seriously wrong, a new power station, at Searsburg, Vt., embodies astonishing mechanical intelligence.

The turbine of the plant drives a generator with a capacity of 6500 horsepower. The only help from human beings is occasional inspection, lubrication, and regulation of the governor mechanism.

The turbine starts when sufficient water arrives and shuts down when the flow falls below an efficient limit.



Below: The largest automatic power control station in the world, at Searsburg, Vt. At right: Interior view showing controls that set the governor mechanism going

Illuminated Mirror Will Make Shaving Easier

ADJUSTMENT of the shaving mirror to reflect adequate light on the face always has been a problem to the self-shaver. Now from England comes a shaving mirror equipped with a small electric lamp that is said to assure the user a perfect light in the correct position.

The lamp is placed in the bottom of the mirror and is adjusted so that it illuminates only the lower part of the face and protects the eyes from glare. It also warms the surface of the mirror slightly and thereby prevents condensation of steam from the basin or bath, with consequent blurring of the mirror.

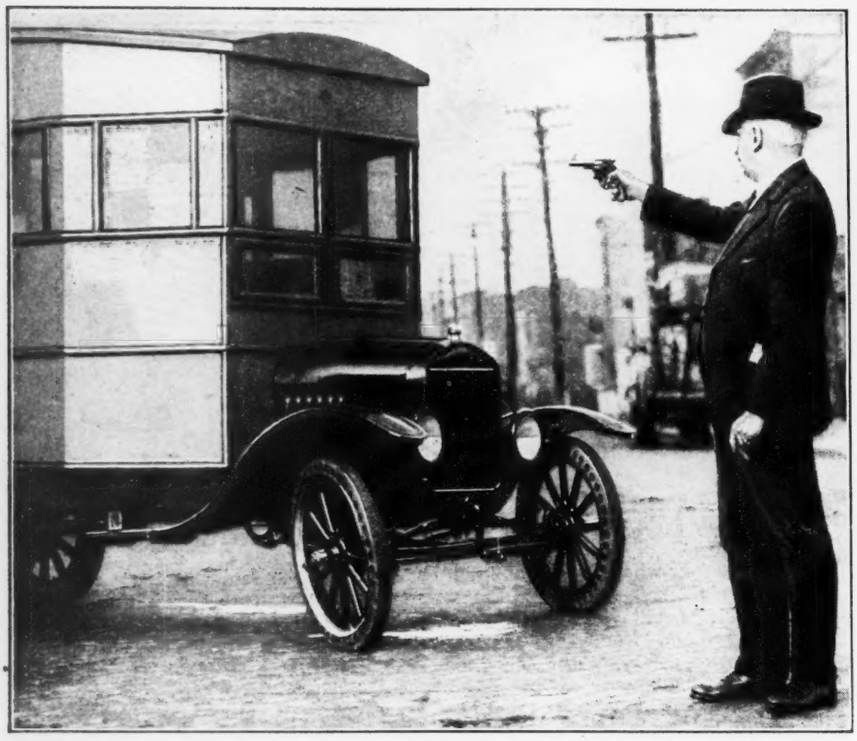
A battery supplies the current, permitting the mirror to be placed wherever desired.

Making Paper Fireproof

PAPER can be made fireproof by saturating it with the following solution:

Ammonium sulphate, 8 parts.
Boric acid, 3 parts.
Borax, 2 parts.
Water, 100 parts.

A solution of sodium tungstate has the same effect, but is more expensive.



Bullet-Proof Express Car Defies Bandits

DECLARED to be bullet-proof and to be capable, with tear or ammonia gas, of driving off a bandit gang or a mob, this new armored car seems likely to prove a powerful weapon against the increasing banditry in our larger cities. It is adapted especially to the transportation of payrolls and compact valuables, a task in which loss of life and property now is heavy.

Steel armor plates, of a patented construction, fit about the car in such a way as to obviate welding. Although light, these plates are said to repel bullets even at very close range. Loopholes protected by steel shutters permit the guards within to fire upon attackers. Bullet-proof glass protects the driver.

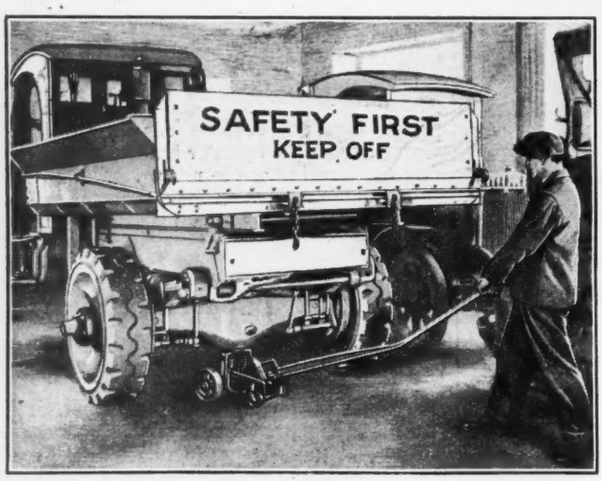
Pipes, perforated to spread such gas as ammonia or tear gas, extend around the outside of the car. The flow of gas is controlled by valves, making it possible to concentrate the cloud at a particular point. Ample space is provided inside for the load and guards.

Small Jack Lifts Huge Trucks

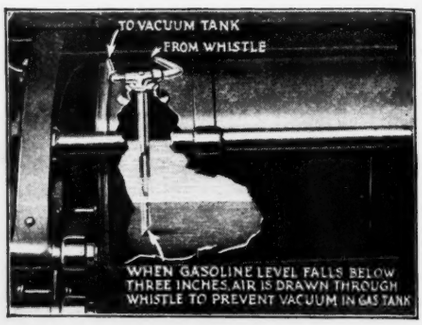
A SMALL jack, weighing about 100 pounds, which permits one man to lift and move the heaviest motor truck, has been perfected by a Michigan manufacturer.

The lifting apparatus is of the ratchet type, and is controlled with an 80-inch handle, thus permitting the jack to be operated in small space. A few strokes of the handle suffice to raise the truck.

Roller bearings and casters make it easy to move under load.



Raising a heavy truck with the 100-pound ratchet jack


TO VACUUM TANK
FROM WHISTLE
WHEN GASOLINE LEVEL FALLS BELOW THREE INCHES AIR IS DRAWN THROUGH WHISTLE TO PREVENT VACUUM IN GAS TANK

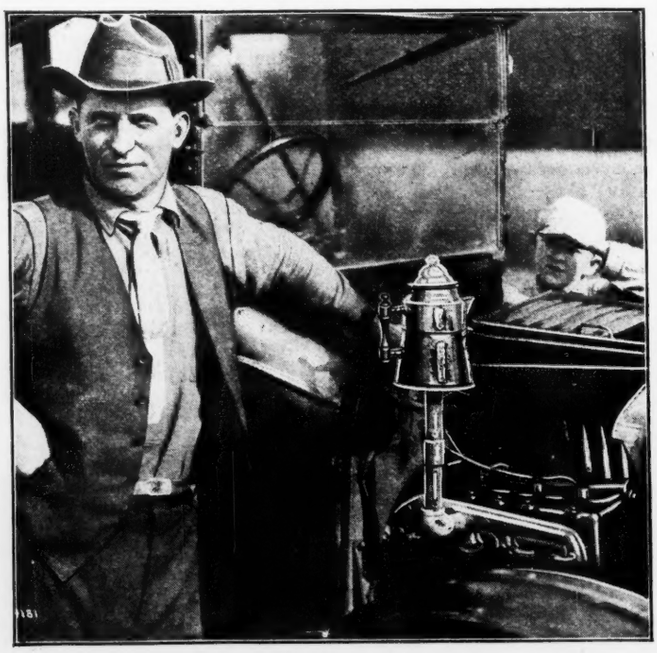
Whistle Sounds a Warning when Gas Runs Low

ABOUT 15 miles before the gas-tank runs dry, a clear, sharp whistle warns the driver of a car equipped with the newly invented gasoline alarm system, shown in the broken-away view above. When the gasoline gets low, the whistle blows intermittently; and when the engine is running on the final filling of the gasoline tank, it blows continuously.

Within the main pipe leading from the gas-tank to the vacuum tank is a secondary pipe leading from a whistle near the driver and extending to about three inches from the bottom of the main pipe.

When the gasoline level falls below three inches, air is drawn through the secondary pipe to prevent a vacuum in the gas-tank. This air, entering at the whistle, sounds it.

AUTOMOBILE accidents now are a major cause of death, showing a rate of 15 every 100,000 persons, according to the records for 1923.



Exhaust Manifold His Cook-Stove

SHORT pieces of pipe, specially constructed utensils, and a Ford exhaust manifold cook the wayside meals of J. D. Jackson, of Candler, N. C., shown above with his ingenious auto cook-stove.

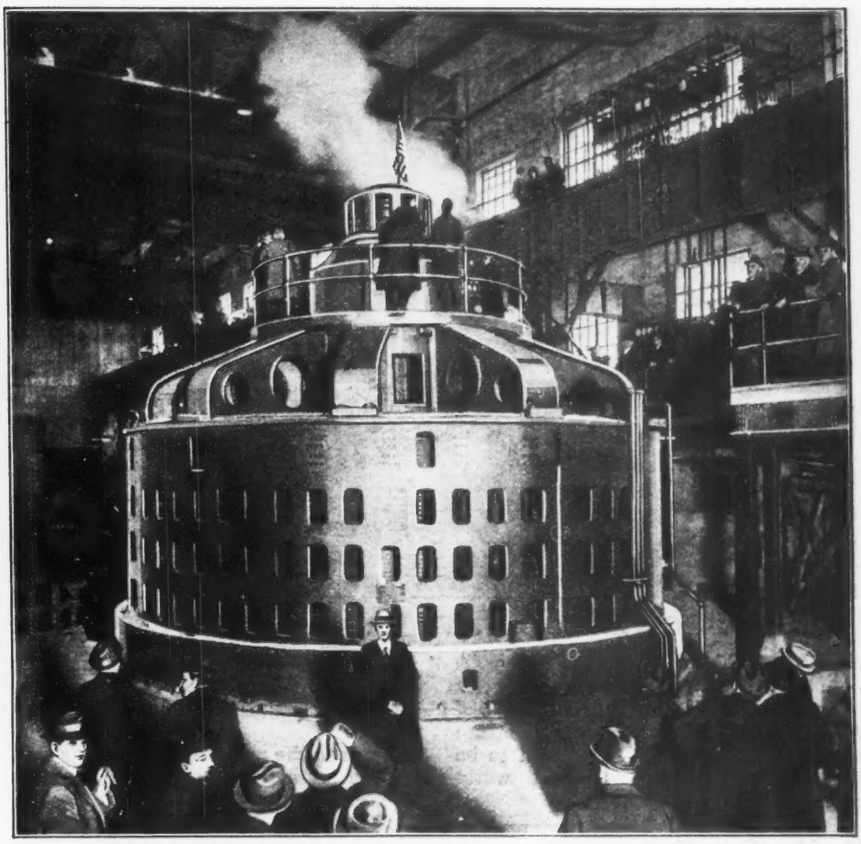
A short pipe with an elbow is welded to the manifold. Another pipe leads up from the elbow to a sleeve, into which is screwed a smaller pipe. The cooking vessels have a double bottom, into which the smallest pipe fits. Heat from the manifold thus is directed against the inner bottom of the vessels.

Pre-Heating Manifold for Quick Auto Starting

WITH the first cylinder explosion, a continuous stream of hot exhaust gas starts circulating through the dome cap of a newly invented pre-heating manifold attachment for automobile engines. This cap becomes very hot, thoroughly transforming the spray flung against it from the carburetor nozzle, it is claimed, into dry, highly explosive vapor, which it delivers to the engine cylinders.

Arrows show passage of fuel through hot dome of manifold

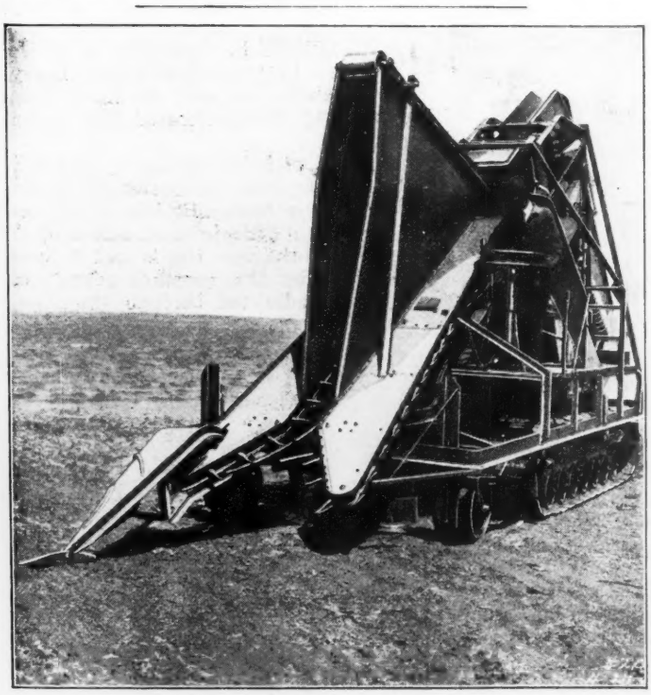
Besides obviating prolonged manipulation of the choker while warming up the engine, the danger of flooded cylinders, wet plugs, and diluted lubricating oil are eliminated, it is claimed. The attachment is easily installed, no change in the original controls being required. From 25 to 35 miles to a gallon of gasoline is said to be possible with its use.



The World's Greatest Water Wheel

THE world's largest and most powerful hydroelectric unit, a giant hydraulic turbine generating 70,000 horsepower, went into action recently at Niagara Falls.

This mammoth unit, weighing 1750 tons and revolving 107 times a minute, uses 3500 cubic feet of water a second, with an efficiency claimed to be more than 93 per cent. Exactly this quantity of water was used by the seven 5000-horsepower units that it replaced, so its efficiency is precisely twice as great.



Sugar Cane Harvested by Machine

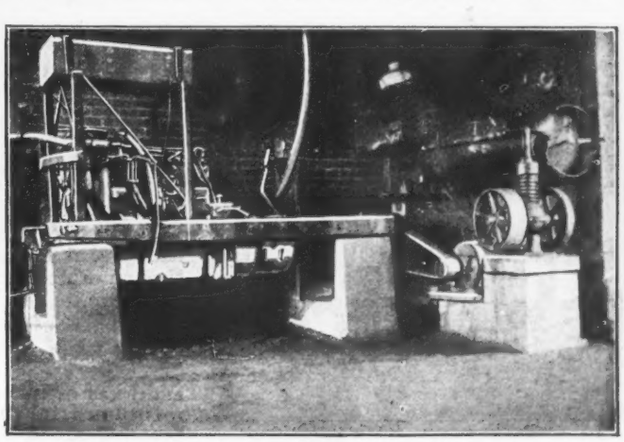
SUGAR cane, which has been cut by hand for centuries, now is harvested by this huge motorized machine that does the work of 100 men.

The stalk is cut close to the ground by a horizontal circular saw. The loose stalks then are gathered by a series of hooks that carry them to stripping knives, where waste is cut away and dumped into a trailer at the rear.

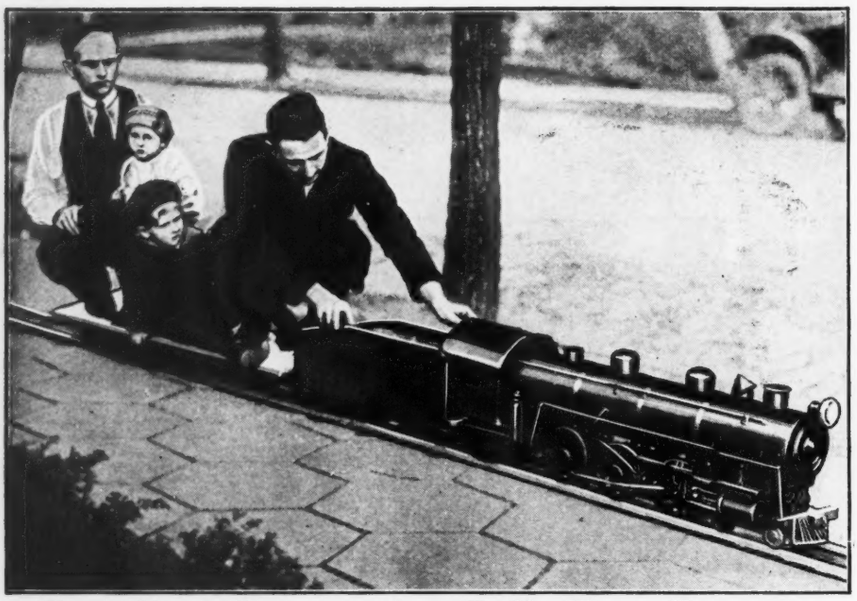
Old Auto Engine Lights Village

WHEN his automobile became too dilapidated for public appearance, A. F. Haas, of Prairie Home, Neb., used it as a municipal lighting plant. He supplies current for twenty-eight 75-watt lights, four 150-watt lights, and two flatirons, and asserts that he could supply double the quantity. Just before twilight he starts his engine, speeds it up—and the town lights up.

The first step in the installation was the purchase of a second-hand generator. Mr. Haas then cut the car frame down, extending the drive shaft through the rear cross-member of the steel frame and keying it there to a drive pulley to the generator. Engine and generator rest on concrete supports. A strap-iron frame surmounts the engine and supports the fuel tank.



The homemade lighting plant, showing auto engine and generator



Four-Foot Locomotive Pulls Four Persons

A FOUR-FOOT locomotive that pulls three or four persons on a tiny flat car was built recently by R. H. Harris, of Atlanta, Ga., to demonstrate a steam valve he had invented. It is said to be the smallest locomotive in the world capable of pulling an adult.

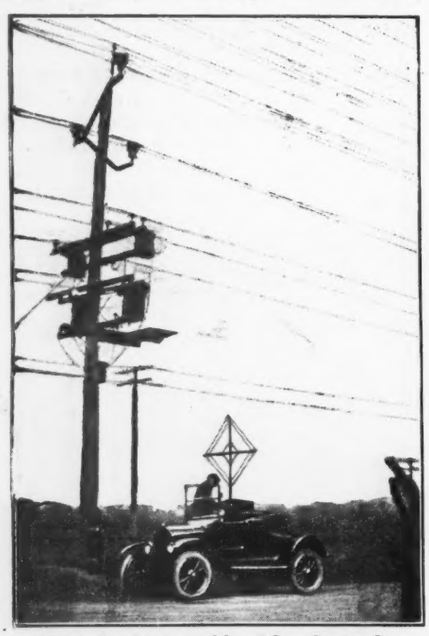
The tender is two feet long and the driving wheels are only six inches high. Under full steam it develops 1½ horsepower.

Down to the minutest detail, it is said to be a miniature of the full-sized locomotive.

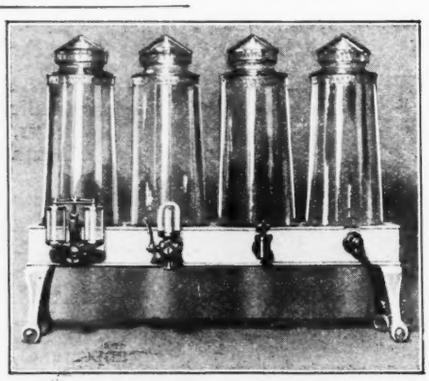
Radio Set Detects Trouble on Power Lines

USING a portable radio receiver with a loop aerial, trouble hunters for light and power systems now declare they can detect infallibly any broken insulators or electrical leakage on transmission lines, without the necessity of stopping the trouble car or climbing poles.

The radio detecting apparatus is the discovery of George W. Hammill, superintendent of the Arkansas Valley transmission lines of the Southern Colorado Power Company. It is said to eliminate the hazard of climbing poles to high-tension wires, and to require fewer men.



Detecting line trouble with radio outfit



The two soda-fountain containers at the left are equipped with the new dispensing valves

New Dispensing Valve for the Soda Fountain

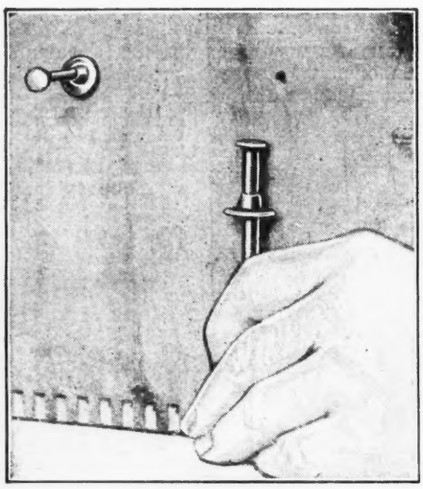
THE annoyance of dripping faucets and the overflowing glasses at the soda fountain has been remedied by the invention of a dispensing valve, by which a predetermined quantity of any liquid, such as soda and chocolate, may be drawn. Just enough to suit the user's taste will come out of the valve. The amount is gaged by marks on the glass cup of the valve.

Its inventor says it will save time and prevent waste at fountains in hotels and restaurants, or wherever liquids are dispensed in small quantities.

The flow of liquids is controlled by a handle that opens and closes valves so that an exact quantity will flow into the valve cup.

THE Editor will be glad to supply, wherever possible, the names and addresses of manufacturers of devices mentioned in this issue of POPULAR SCIENCE MONTHLY.

Nail-Pulling Made Easy by Slip-On Collar



TO SAVE the lumber lost by splitting when temporary structures are being torn down, and the time lost in pulling recalcitrant nails, these metal nail collars have been invented.

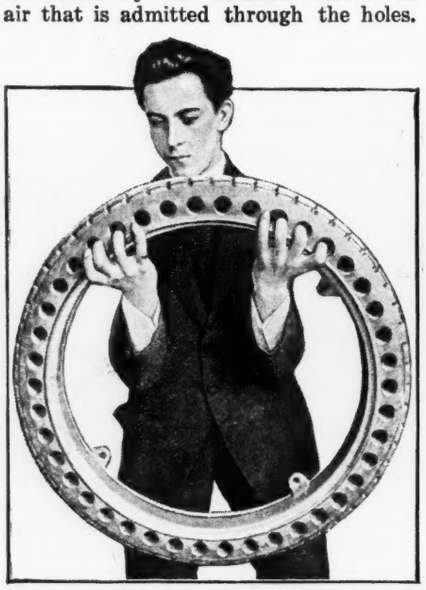
Before the nail is driven, one of the collars is slipped over it, preventing it from entering the wood quite all the way. Thus a hammer claw can be slipped under the nail head, removing the nail easily.

It is claimed that from 30 to 50 per cent of the time heretofore required for dismantling scaffolding can be saved by use of this invention.

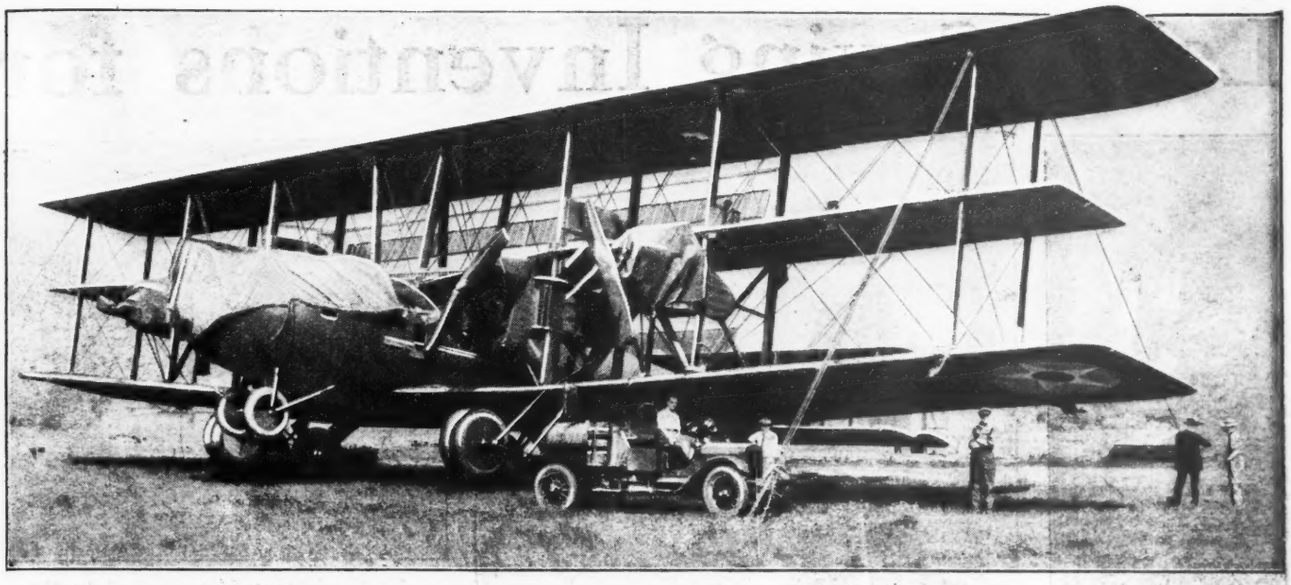
Solid Tires Cushioned by Perforations

RESILIENCY in the solid type of tire required by trucks and other heavy motor vehicles is said to have been achieved by the perforated tire shown below.

A series of holes, closely spaced and more than an inch in diameter, circles the tire near the bead. Besides giving resiliency with little internal stress upon the rubber, the new tire is said to cool the center by the constant current of air that is admitted through the holes.



The new solid tire, showing perforations



Barling Bomber, World's Greatest Plane, Soon May Be Surpassed

WILL the coming summer see new records in the conquest of the air—surpassing even the amazing feats of airplane construction and operation of a year ago?

The giant bomber shown above, designed by Walter H. Barling and successfully tested at McCook Field, Dayton, Ohio, last summer, still retains its place as the largest airplane in the world. Yet the United States Army Air Service is reported to have planned the construction of other planes of similar type, but still larger!

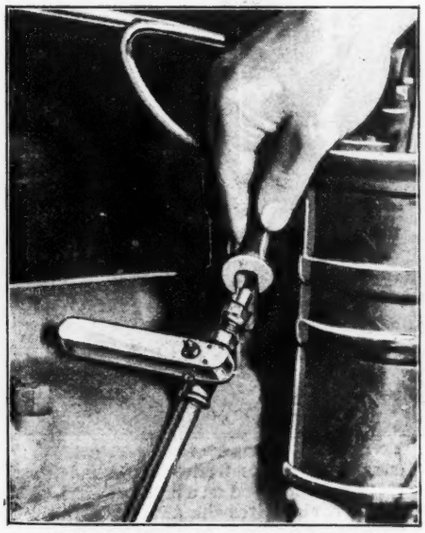
With a wing spread of 120 feet, this giant is said to be capable of carrying enough explosives to wreck any modern city. Its fuselage is 55 feet long and 10 feet in diameter. Driven by six 450-horsepower Liberty engines, it is designed to fly at not less than 90 miles an hour.

Manifold Inlet Valve Is Designed to Save Gas

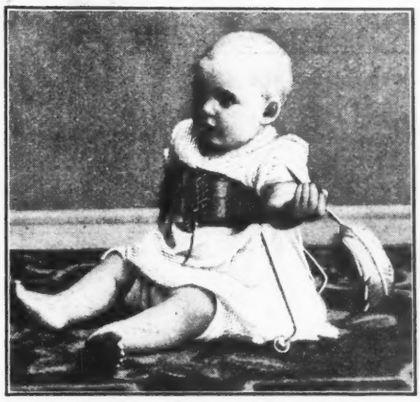
ADMITTING air directly into the manifold in front of the butterfly valve of the carburetor, a new gasoline saver—an inlet valve—is claimed to effect unusual economies.

It is attached to the vacuum tank connection and extends over the engine block. When the motor is cold, the valve remains tightly closed, permitting a start on a rich mixture. But as the engine warms up, the heat causes a thermostat in the valve to open gradually. The hotter the engine, the leaner will be the mixture entering the carburetor.

The attachment can be installed in a few minutes, and is claimed not to decrease the power from the engine. It is easily adjustable.



Adjusting the inlet valve attachment



Three Wire Legs Safeguard the Creeping Baby

THE baby can crawl, but he cannot fall backward, if he is wearing this new guard. Three wooden balls tip three sturdy wire legs that support a padded belt fastened about the baby's body.

Advise Diet of Sea Fish to Prevent Goiter

GROWING girls should eat sea fish and shell fish, particularly oysters, clams, and lobsters, several times a week, advises the United States Fisheries Service, for these foods have a high content of iodine, useful in preventing goiter, to which girls are susceptible.

Medical science says that goiter is caused by the failure of the thyroid gland in the neck to function, because the body is not receiving sufficient iodine. Epidemics of goiter usually are traced to insufficiency of iodine in drinking water. For this reason many communities have added iodine to their water supplies.

All-Season Door Contains Interchangeable Panels

SCREEN doors in summer and storm doors in winter—without touching the hinges. This feat is said to have been made possible by interchangeable door panels lately placed on the market.

Turning four screw locks a quarter of a turn each attaches a panel to the door frame or releases it when it is to be removed. This operation is said to require less than half a minute.

A wide variety of panels is available, providing an all-season combination door. No planning nor fitting of panels is required.

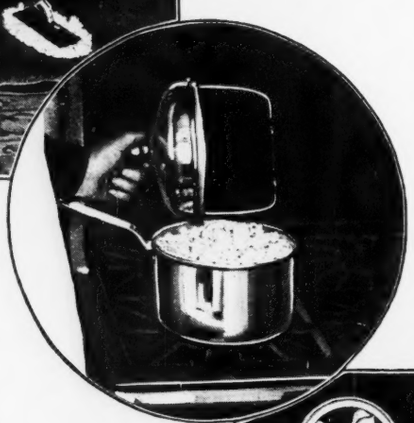
Removing the storm panel for summer

Labor-Saving Inventions for

A strong strip of steel shaped so that it can be run through the handle of the door and around the shank of the door knob is designed to prevent burglars from pushing out the key

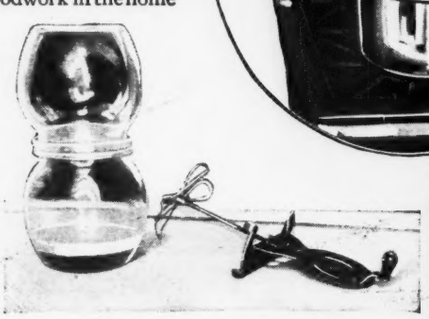
A dust-mop attachment for the vacuum cleaner is designed especially for cleaning hardwood floors and all woodwork in the home

An aluminum saddle attached to the back edge of the paring-knife near the handle is shaped to fit the crease of the forefinger knuckle, preventing soreness or callouses. It also serves as a guard



No shaking is necessary with this aluminum corn-popper, which becomes an ordinary cooking vessel when the stirring frame is removed. Turning the knob of the cover stirs the frame through the corn

A glass of water cannot spill if set in this wall bracket that folds back out of the way when not in use

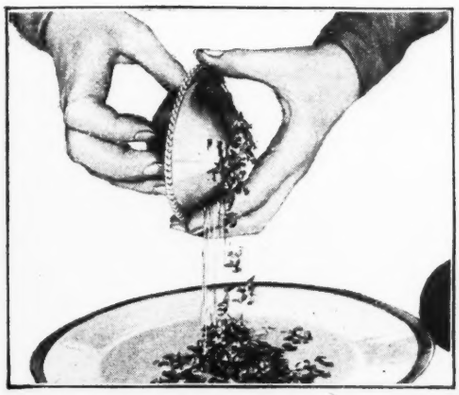


Mayonnaise, cream, or light dough is beaten conveniently in this small kitchen churn. The cover has a funnel

Here is a new mop that is unusually easy to attach to the handle. The mop head is threaded over the supporting frame as a curtain is pulled over a curtain rod. At the top of the swab is a hem through which the rod is pushed. When dirty, the mop may be removed and washed easily

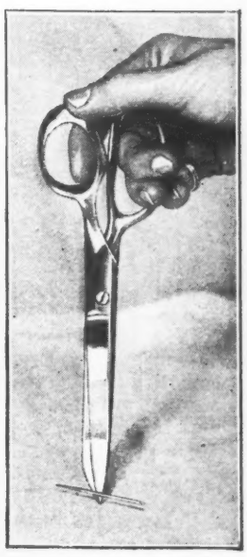
To avoid the danger of summer colds caused by drafts from electric fans, this fan is mounted on a high pedestal, where it circulates the air of a room without directing breezes on the unprotected heads of the occupants

the Well-Equipped Household

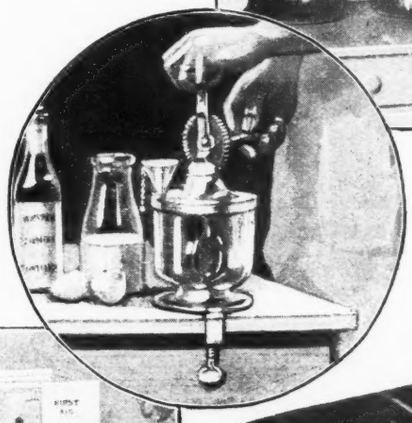


The vegetable and fruit shredder shown above will shred oranges for marmalade or vegetables for soups and gravies. It is saucer-shaped and its surface contains a number of holes edged by cutters. These separate the fruit or vegetable into thin, flaky bits when pressed against it

This adjustable silver casserole stand is latticed to fit any one of the 16 glass baking-dishes of different sizes shown above



Shears with magnetized points are handy for picking up pins and needles from the floor, or for finding lost needles

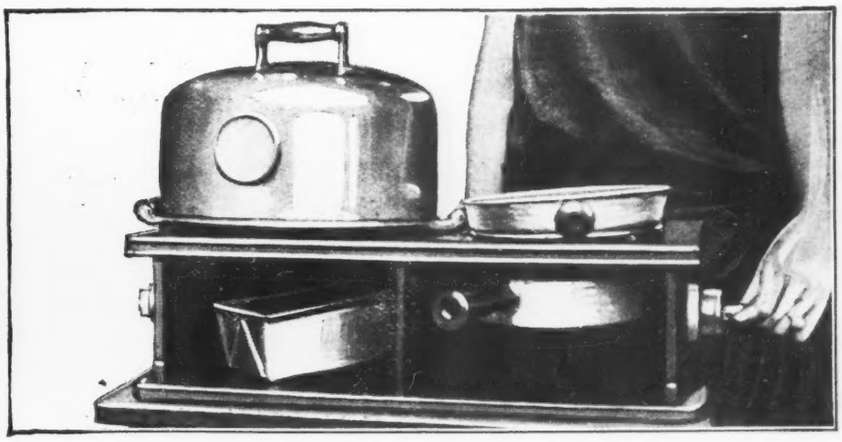


The egg-beater shown at the right can be clamped to a table, preventing the container from slipping. The clamp is attached to a covered glass bowl into which the beater is inserted

Here is an unusually compact wardrobe suit case especially useful for the man who travels extensively. It is especially designed to hold a coat without folding or wrinkling

This midget can-opener, less than two inches long, folds flat and may be carried loose in the pocket or on a keyring

A combination dressing-table, toilet cabinet, and medicine chest. The front of the large door is a mirror. It is fitted with shelves and drawers



This compact electric range cooks food in three vessels and an oven simultaneously. The heating plates radiate heat upward and downward. A reflector plate is used to concentrate heat in one direction only if so desired. The oven on top at the left is equipped with a gage indicating amount of heat

Locomotive on Runners Hauled by Horsepower

WHEN engineers found it necessary recently to transport a small railway locomotive many miles over a frozen Canadian prairie, the locomotive had to accept help from horses to make the journey, for there was no railroad over which it could transport itself.

The engine was placed on rugged, specially built runners and dragged the entire distance by 12 horses.

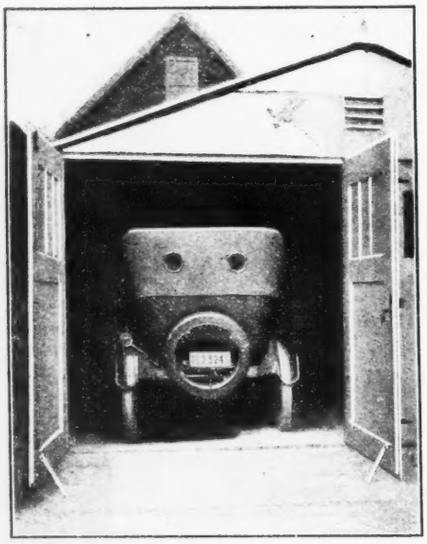
World's Largest Insulator Weighs 506 Pounds

THE latest high point in the steadily increasing dimensions of electric insulators is the giant pictured below, which weighs 506 pounds unfilled. It will be used to introduce conductors into the switch gear of a 150,000-volt power transmission station at Hermsdorf, Germany.

The mammoth duct is 10 feet high and more than two feet in diameter. In recent tests its insulating qualities were found sufficient to withstand a pressure of 320,000 volts in dry weather and from 250,000 to 300,000 volts in wet weather.

One of the chief problems encountered in transmitting high-tension current has been to develop insulators capable of withstanding high voltages. This huge insulator represents a recent development.

This giant insulator is 10 feet high



Hinged Spikes Form Stops for Garage Doors

TO PREVENT open garage doors from swinging inward against an entering automobile and so damaging fenders or windshield, a Milwaukee, Wis., manufacturer has devised the simple door stop pictured above.

The device is a sharp-pointed galvanized iron spike pivoted loosely to the lower rail of the door. When the door is opened, the spike is dragged along the floor of the entrance. But any motion of the door inward drives the point of the spike into the floor, preventing the door from swinging.

When not in use, the stop fits into a door socket, yet it is easily accessible when the driver wishes to enter the garage.

Fishes Heed Noon Whistle

ADDITIONAL evidence that fishes are able to hear has been produced by a German scientist. He fed blind fishes to a musical accompaniment. After the sixth day of this treatment, the fishes always came up to the surface when the whistle blew. Once learned, the trick was never forgotten, the fishes always appearing on time during the 30-day test.

Inexpensive Razor Strop Made of Steel

A RAZOR strop made of a thin band of steel, is becoming popular in England, where it recently was placed on the market. It cannot be cut and marred, as can the ordinary leather strop, and is said to be inexpensive in comparison.

A special lubricant must be used to get the best results, which are said to be fully equal to those obtained with the ordinary strop. The method of stropping the razor blade with the new device is unchanged from the old way.

The steel razor strop

MORE than 25,000 birds were banded last year for migration study by the United States Biological Survey.

Small Eye-Shades Clipped to Rims of Glasses

TWO small "blinders" of green celluloid, that can be attached to the rims of eyeglasses by means of metal clips, are the latest substitute for the old-fashioned eye-shade that projected from the forehead.

Many of the shades now in use may cause injury, specialists declare, because of the fact that they are attached to the head by an elastic band that exerts constant pressure on the forehead and eye nerves.

The tiny new shades are designed especially for use in reading or other close work, to protect the eyes from glare. It is clear that the smaller shades are less clumsy than were the large ones.

Small celluloid shades attached to glasses

Travelers' Wardrobe Trunk Folds into Small Space

WEIGHING only 20 pounds and folding to a size that can be carried like a suitcase, a remarkably compact wardrobe trunk for travelers will hold six women's garments or four men's suits.

It can be opened halfway, placed upon a chair and packed, or used as a wardrobe.

The small wardrobe trunk as it appears when closed (above) and when opened (left). Note the bottom compartment for miscellaneous small articles

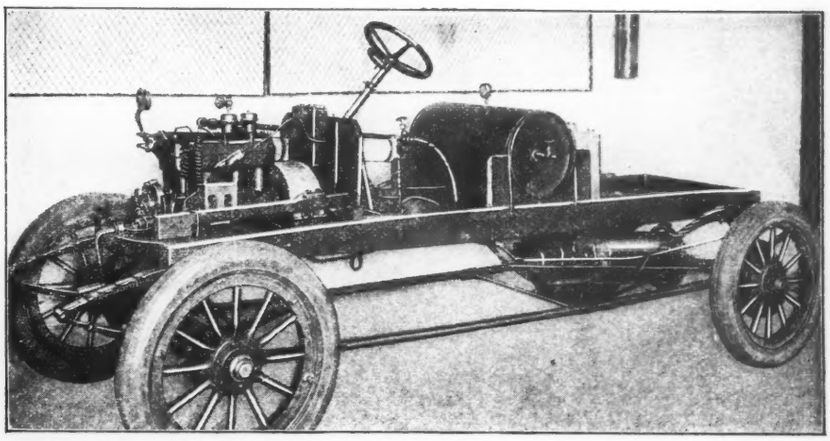
Also it will open fully, the bottom and sides making a continuous, flat surface. At the bottom is a compartment for miscellaneous small articles. It is equipped with a cover that is said to make it dust proof and waterproof.

New Head Phones for Radio Hang on the Ears

OBVIATING the annoying headband of ordinary radio head phones, newly invented phones that hang on the ears should find favor, particularly with feminine fans, whose coiffures the usual headband disarranges. It cannot press the head uncomfortably nor be made useless by a broken headband.

The instruments are said to amplify sounds from 15 to 20 per cent. This amplification is said to result from an air cushion formed between the ear and the diaphragm by the unusual construction of the phone.

How the head phone hangs on the ear



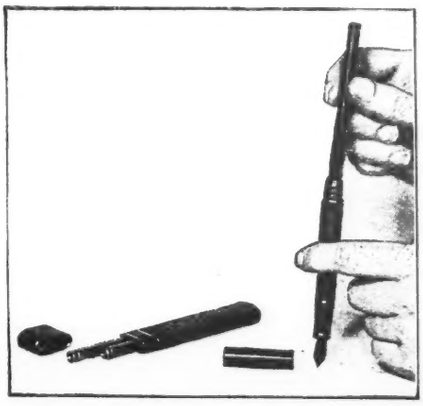
Gearless Auto Is Driven by Compressed Air

A GASOLINE automobile without radiator, clutch, transmission, drive shaft, or universal joint, has been invented by H. R. Spangler, of Pueblo, Colo. The car is propelled by compressed air.

The power plant is a modification of a four-cylinder gasoline engine. Two of the cylinders are converted into an air compressor and are driven by the remaining two cylinders, which constitute the gas engine. In half a minute the compressor is said to fill an air tank to an operating pressure of 50 pounds.

The engine is adjusted to maximum efficiency on installation. When the pressure in the air tank reaches a given amount, the gas engine is shut off automatically. After the pressure drops below 50 pounds, a spring valve permits the air to return to the air cylinders, forcing the pistons into action and thus serving as a self-starter for the gas engine. In this manner the engine is said to maintain a 50-pound pressure.

The only speed control is a lever on the steering wheel that governs the amount of air passing through a small pipe from the compressors to an air engine on the rear axle that drives the wheels.



Ink Cartridges to Insure a Full Fountain Pen

DRY fountain pens have thwarted many a plan and embittered many an hour. Perhaps this new case of ink cartridges was the fruit of some such hour.

The case contains three metal cartridges, each of which can be slipped into the barrel of the pen in place of the emptied cartridge. The case can be carried conveniently in the vest pocket, and the cartridges are sealed against leakage or deterioration of their contents.

A slight turn of the cartridge after it has been inserted in the pen tightens it.

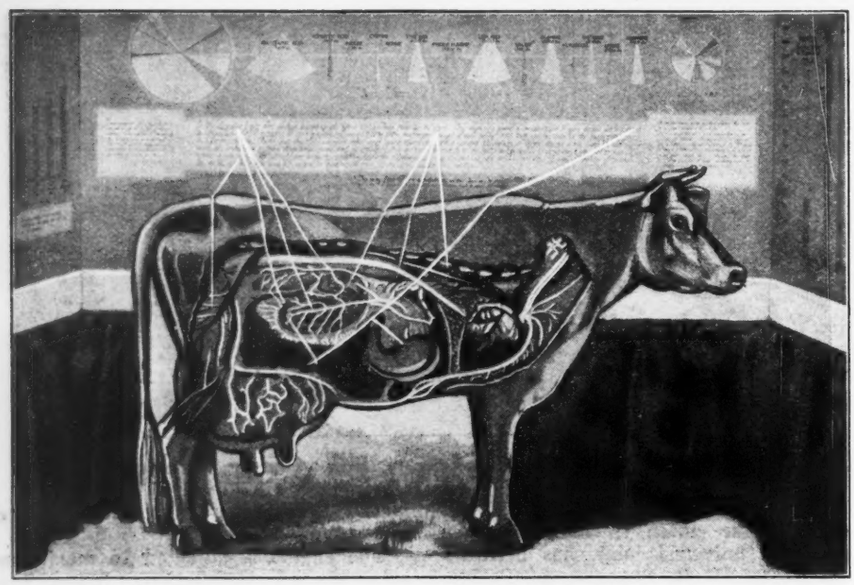
Charcoal Gas Drives Auto

AN AUTOMOBILE propelled by gas generated from the combustion of charcoal was tested recently in Lyons, France, before government officials and technical experts. The machine is reported to have traveled 60 miles on 33 pounds of charcoal costing 25 cents, or one fourth the cost of gasoline. The charcoal gas is generated in a furnace compartment.

Cane Holds Baby Carriage

A COLLAPSIBLE baby-carriage attachment for a walking-stick has been devised by an inventive London parent. The wheeled carriage is fastened to the stick by two thumbscrews. When not in use it can be folded flat.

Carriage fastened to the walking-stick

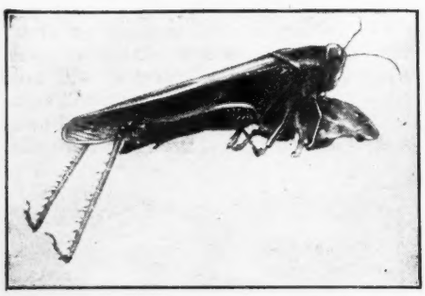


Rubber Heart Beats in Lifelike Model Cow

A MODEL cow of life size with one side cut away to reveal internal organs and a circulatory system constructed of thin rubber, through which "blood" ran, was a feature of a recent exhibit by the United States Department of Agriculture. A rubber heart, actuated by an air pump, simulated the pulsations of the actual circulatory system.

The chief purpose of the model was to make clear how cows might be made to produce more and better milk by giving them feeds containing the proper proteins. The model revealed how these proteins are broken up by the digestive system into the acids that the blood stream carries to the udder, where they are built up into milk proteins.

Four-Inch African Locust Feeds on Mice



IF YOUR cat is no match for the household mice, you might try a locust. Of course an ordinary field locust would not do, but the species shown above, four inches long, would.

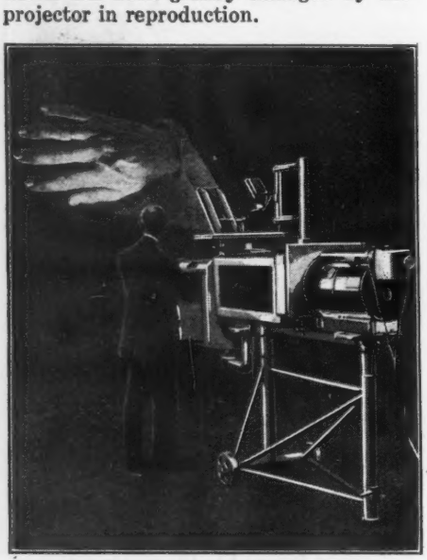
This African insect, caught while feeding upon a mouse, was killed and, with his victim still in his clutch, was taken to the South Kensington Museum, London. The species is said to be the only insect that feeds on four-footed animals.

Projector Shows Pictures in Three Dimensions

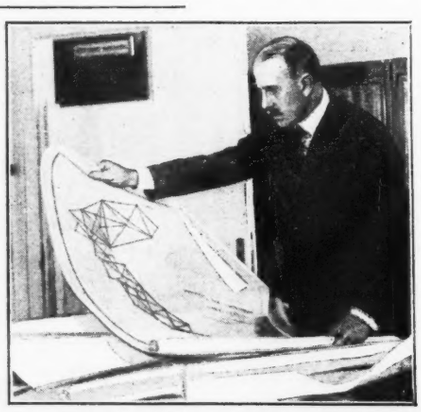
THE spectral effect of this hand, reproduced on the wall in vividly lifelike form, is the achievement of a three-dimensional projecting machine recently perfected in Germany.

Until recently methods of projection have shown the projected objects as two-dimensional. The old-fashioned stereoscope gave three dimensions, but it was not a projector. This new invention is said to achieve depth or perspective and without the use of a screen.

The illustration reveals how startlingly accurate is this projection. Each wrinkle and vein are clearly visible on the hand, which has been greatly enlarged by the projector in reproduction.



Projecting a hand in lifelike dimensions



Offers Plan to Forecast and Chart Earthquakes

EARTHQUAKES will be forecast as accurately as storms now are, if Major William Bowie, of the United States Coast and Geodetic Survey, achieves the results he expects for his recently perfected plan of mapping and charting earth tremors in advance.

Basing his theories on a painstaking correlation of all known facts about earthquakes, he believes he has developed a reasonably dependable system. It is expected that shortly he will be placed at the head of the country's first earthquake station. The photograph shows him charting the probable effects of a predicted minor quake.

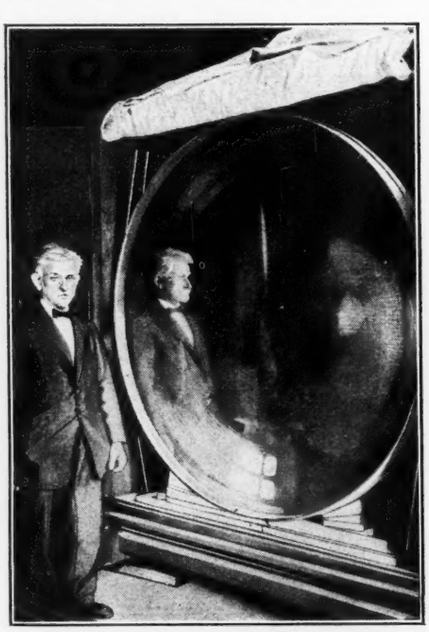
DISCOVERY of a fluid that, when injected into the blood, strengthens the white corpuscles against disease, is claimed by Dr. Burr Ferguson, of the United States Health Department. The fluid, he says, is based on salicylate of mercury.

Mammoth Lens Made for Movies of Mars

MOTION-PICTURES of the planet Mars will be taken this summer, if the plans of Dr. David Todd, of Amherst College, mature. In August, when the feat will be attempted, Mars will be nearer the earth than it has been in 500 years, and nearer than it will be within the next 500 years, astronomers tell us.

A specially constructed $3000 camera and a reflecting telescope, using the largest lens ever ground for one of its type, will be used. This giant lens, five feet two and a half inches in diameter, was bequeathed to the American University, Washington, D. C., in 1903, by Rev. Dr. John Peate, a retired minister, who made it.

The negative to be obtained, even after three enlargements, probably will be about the width of a dime. With good fortune, it might be wide as a quarter.



World's largest reflecting telescope lens

A Creature Four Hundred Million Years Old

FOUR hundred million years ago, a time so hoary that only the oldest rocks bear any record of it, this curious, long - extinct creature, a trilobite, was one of the highest forms of life our earth boasted.

This specimen, now in the Field Museum of Natural History, Chicago, was found in northern New York, where it had lain, deeply buried, since Paleozoic time. It is shown curled up, the top half being the head and the lower half the rear part of the creature.

Protected by his jointed, armor-like shell, the trilobite crawled along the bottom of primeval seas and along their beaches.

Deny Increase in Insanity

THAT alcoholic insanity has increased since prohibition is emphatically denied in a bulletin of the National Committee for Mental Hygiene, which states that as compared with 1919, the year 1922 shows a decrease in mental cases from this cause.

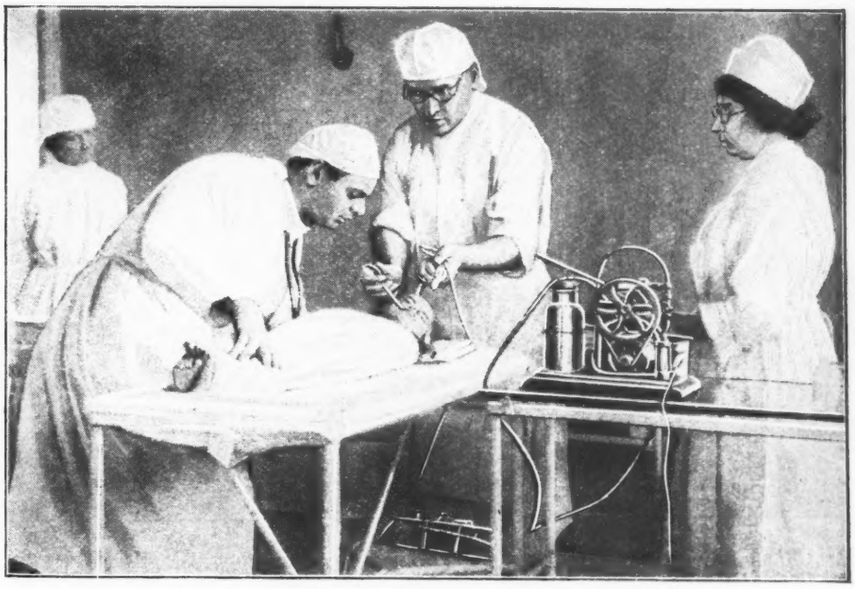
Data from 100 hospitals for mental disease showed that of 35,000 cases in 1922, less than four per cent were the result of alcoholism, the report says.

The World's Tallest Cabbage

THE treelike vegetable pictured below is said to be the tallest collard—a kind of cabbage—ever grown. It is approximately one year old and is seven feet 10 inches high.

The giant plant is from the farm of J. W. Harkey, near Sanford, Fla.

Giant collard, nearly eight feet tall

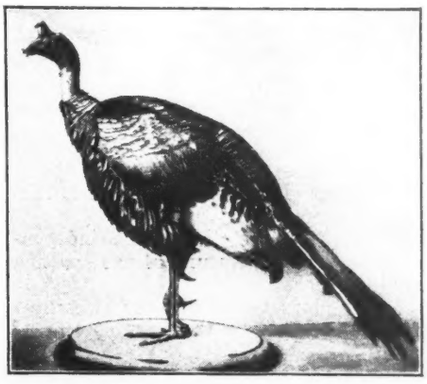


Electric Pump Is Victor over Diphtheria

A TINY electric suction pump is the latest scientific weapon against the scourge of diphtheria. It is said to have reduced the death rate of this disease from 33⅓ per cent to 10 per cent at the Kingston Avenue Hospital, Brooklyn, N. Y., the first institution to adopt it.

The life of five-year-old Muriel Carlson, of Brooklyn, was saved recently by its prompt use. Her throat was nearly closed and her breathing barely perceptible when the new instrument was set to work. Almost instantly the pump loosened the throat membrane and within a few minutes a silver breathing tube could be inserted.

The pump, the invention of Dr. H. L. Lynah, of New York City, is expected to save the lives of many thousands annually throughout the country.



New Turkey May Add Zest to Thanksgiving

FLAVOR of the nation's Thanksgiving turkey may be improved by experiments undertaken by the United States Biological Survey, which is trying to acclimate the ocellated or spotted turkey—a wild species of Central America. A number of the birds recently have been transplanted to a lonely island off the Georgia coast. If this effort is successful, attempts will be made to breed it with our domesticated turkey, which is of Mexican origin.

The ocellated turkey takes its name from the "eyes" sprinkled over its gorgeous tail feathers. Few feathered creatures surpass it in beauty of plumage. Its back is blue tipped with red, and its wing coverts, legs, and feet are a handsome red.

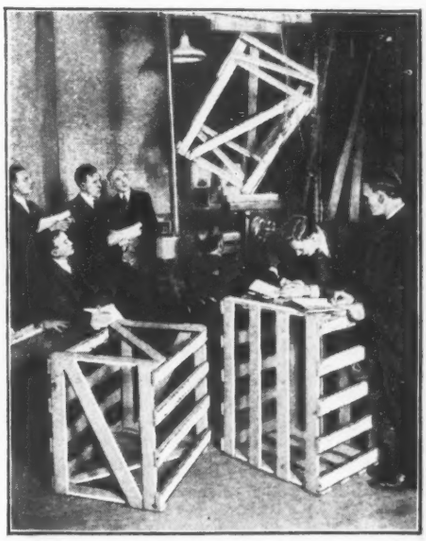
The bird is shy, but prefers the open to the woods. It is about the size of our own turkey, and the meat is said to be unusually tender and savory.

The Strongest Crate Made with the Least Lumber

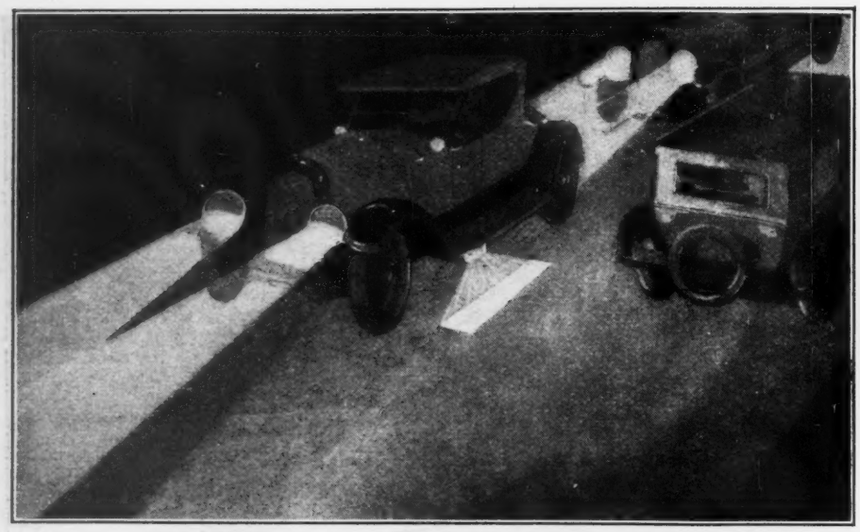
THREE common styles of crate bracing were subjected to rigorous tests recently by the Forest Products Laboratory of the United States Forest Service, at Madison, Wis.

The crate with a single diagonal brace on each side, the one shown below under test, withstood double the diagonal compression that distorted the crate on the floor at the right. It offered a maximum of rigidity with minimum lumber.

A combination of diagonal and parallel bracing was found to be desirable only in packing certain rigid contents.



Laboratory experts testing crate strength



Auto Sidelight to Assure Safe Clearance

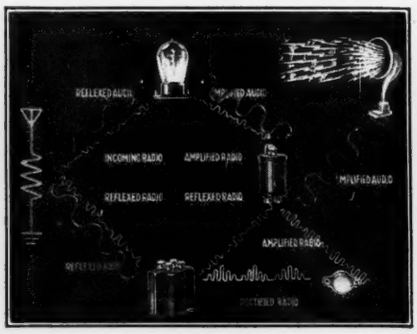
A POWERFUL green light, claimed to be visible twice as far as auto headlights in any weather, is directed forward by this new side safety light attached to the runningboard of the car. It also directs a strong red light rearward.

The green light is said to diffuse the glare of headlights, besides casting a beam that indicates the exact position of the car's extreme edge.

Moreover, it creates a safety zone of white light, six feet long and 14 inches wide, indicating to approaching drivers how closely they may pass. Their near wheels can cut the center of this zone, with 18 inches to spare.

The light is attached close to the front fender on the side of the left runningboard. Thus the driver always can determine, by leaning over slightly, whether it is burning. The red light substitutes for the tail light if the latter goes out.

Illuminated Display Shows Secrets of Radio



THE theory and operation of a popular reflex radio circuit was represented strikingly in a novel illuminated display at a recent radio show.

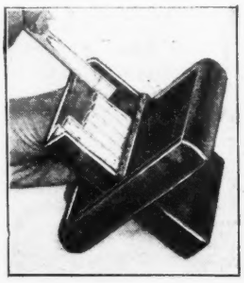
The circuit was shown in a combination diagram and pictorial representation, the apparatus being indicated by glass transparencies and the currents in the various circuits by various sized Geissler tubes.

While all these tubes are lighted in the photograph to show their positions, in the actual working of the model the various circuits are lighted progressively to reveal the action of the currents at various stages of the operation of the circuit.

The display was designed and built by William J. Schnell and W. H. Farr.

Cigarette Box and Stand

A HANDY cigarette box of figured wood is constructed in such a way as to open in the form of an X-shaped stand when pressure is applied to one end of the box. The two halves of the box are pivoted at the center. The device is especially useful as a cigarette stand for the small table.



Hot Plugs Aid Starting

ONE reason why an automobile engine is more apt to balk when starting than after a period of continuous running has been determined by Dr. F. B. Silsbee, of the United States Bureau of Standards for the National Committee for Aeronautics. He has found that the ignition spark will pass more readily when one or both of the electrodes are heated to redness.

This effect is stated to be independent of the temperature of the gasoline mixture.

Spark plugs that make the electrodes run hot therefore are the most efficient.

Aluminum Tripod Gives Cushioning Support

A PNEUMATIC tube in which a supporting post moves up and down on an air cushion is an unusual improvement in this compact all-aluminum camera tripod. The pneumatic cushion permits adjustments with one hand without jar or friction.

When closed, the tripod is 24 inches long and six inches in diameter. It can be folded into a suitcase. It has a large, detachable head, bracing any size or make of camera.

Motorized Platform Replaces Switch Engine

THE costly use of a large locomotive and from two to four men to shunt a few empty box cars has been a source of transportation waste for years. The coal famine in Germany finally forced a solution of the problem, in the form of a shunting platform about the size of an ordinary hand car, driven by storage battery.

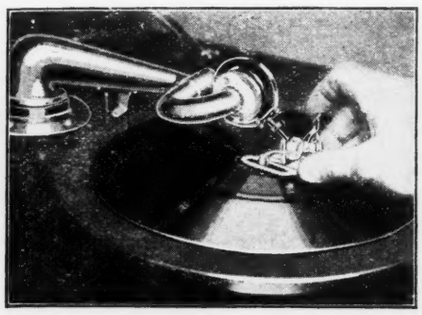
The platform carries the battery, two driving motors, a separate motor for the capstan, rolls for the rope, and footboards from which the driver directs operations.

The capstan makes it possible for the platform, from a stationary position, to move cars and to turn them on a turntable. To turn a car, one end is connected with the capstan by a rope. The motor then winds the rope.

The battery has a capacity of 156 ampere-hours for three hours. The platform can move a loaded car or several empties. Its maximum speed is about five miles an hour.

The small but powerful motorized platform hauling a loaded freight car and three empty cars

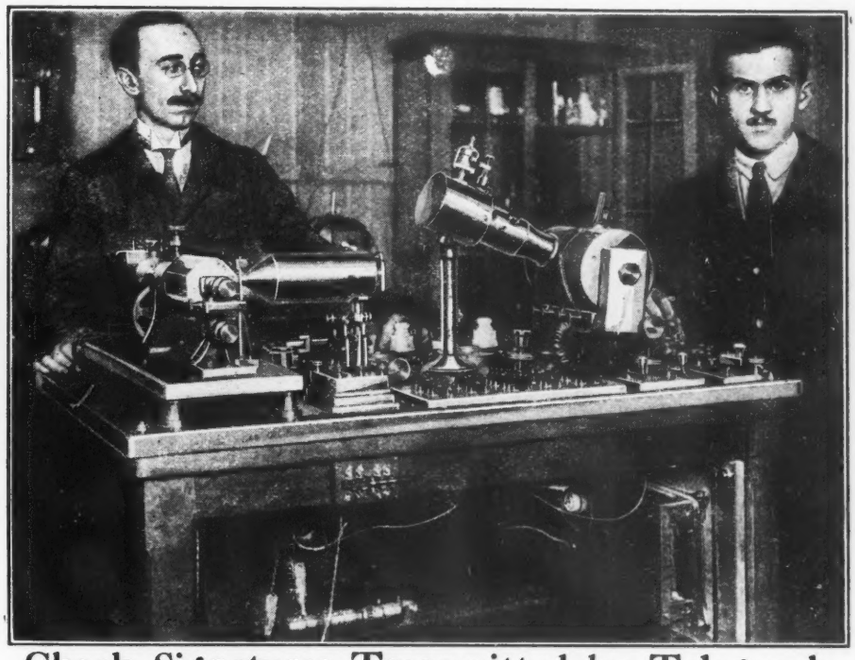
Fiber Needles Sharpened on the Phonograph



FIBER phonograph needles now may be sharpened without removal from the tone arm through the invention of an ingenious new needle cutter. Since needles of this type—preferred by many because of their mellow tone—must be sharpened after completing one or two records, the need for removal heretofore has been an annoyance.

With this new sharpener the needle is slipped into the cutter and the lever pressed down once. A dust and shavings box attached to the cutter catches the chips.

Only a very small portion is cut at one trimming, so that one needle can be used to play many records.



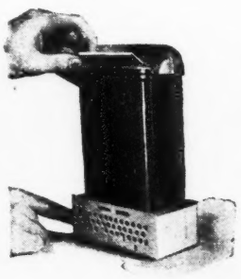
Check Signatures Transmitted by Telegraph

HANDWRITING now is to be transmitted by telegraph as a regular service by the French Post Office Department. Already French banks are honoring telegraphed checks, for a perfect reproduction of the sender's signature is transmitted electrically over the wires.

The illustration shows the belinograph transmitter, which now actually is in operation in many French post offices.

Drowning Mouse Sets Trap for Others

TORTURE dungeons prepared by the arch villains of history and romance—labyrinths with blind passages and stairways with false floors that plunged unsuspecting victims into the pit of death — these had nothing on the newest of mouse-traps.



Rear view of trap, showing death stairway

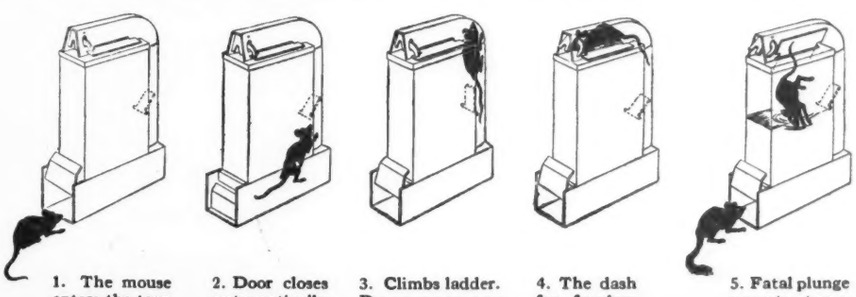
This death chamber for the commonest of household pests may not be the very best mouse-trap ever invented, but undoubtedly it is one of the most intricate. It is arranged so that the mouse, after he has been lured into it, not only shuts and locks the door after him, but all innocently resets the trap for his brothers to follow him to his doom.

The mouse enters the front door of the chamber and moves along a passageway in an attempt to reach the bait, which is guarded by a perforated metal container. As he progresses, his weight on a movable platform automatically closes and locks the door of the entrance behind him. The only apparent exit is an opening at the rear of the passageway, leading to a ladder. To reach the opening the mouse must climb over another movable platform that automatically reopens the entrance door for another mouse.

Now if the trapped mouse should attempt to retrace his steps and escape through the reopened door, the door will be closed in his face automatically by the release of his weight from the platform. So eventually he must climb up the ladder. When he reaches the top, freedom apparently is in sight. At the far end of a level upper passage is a small opening through which shines the light of day. He dashes along the passage, pushes his nose into the opening and—splash! He plunges headlong into the water of a subterranean well from which there is no rescue.

The contact of his nose with the opening has sprung a trapdoor that has dropped him to his death.

And in this last earthly act he has unknowingly reset the trap, preparing the same fate for one of his companions.

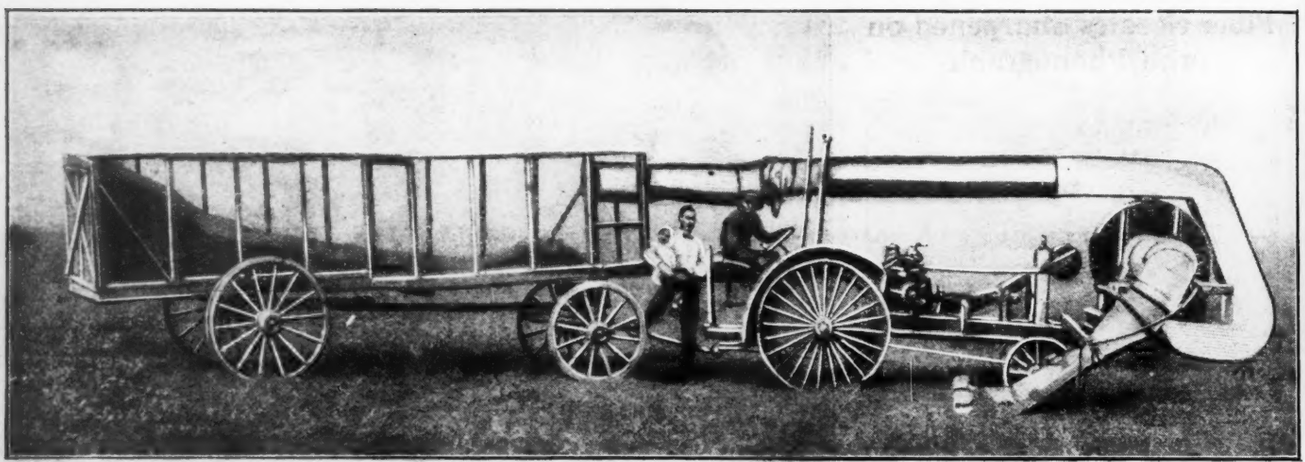


1. The mouse enters the trap
2. Door closes automatically
3. Climbs ladder. Door reopens
4. The dash for freedom
5. Fatal plunge resets trap

Pictures Biblical Stories in Grotto of Rocks

A HUGE grotto built by hand of every kind of stone, mineral, fossil, petrified substance, shell and coral to be found in the United States is the exacting hobby of Rev. P. M. Dobberstein, of West Bend, Iowa.

Primarily, however, the structure is not a geological exhibit but a rock picturization of familiar phases of Biblical history, including the story of creation. The Eden scene already is completed, and several others are well under way. The builder estimates that from six to eight years will complete the undertaking.



Mammoth Machine Harvests 300 Bushels of Clover Seed an Hour

FROM 150 to 300 bushels of clover seed an hour can be harvested by this remarkable combination sweeper, cleaner, and packer, according to its inventor, A. F. Ruff, of Rock Hill, S. C. The hay is left, to be raked into windrows.

The work of more than 100 laborers is said to be equaled by mammoth and ingenious mechanism. A suction fan mounted on a tractor, with flexible and adjustable intake, sucks the seed from the ground and deposits it in the screened and extremely light-framed trailer wagon.

The inventor, shown in the picture holding one of his children, announces his willingness to help any interested farmer to build one, offering full instructions.

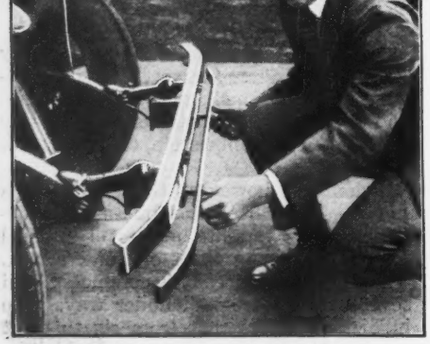
Bumper Stops the Car that Strikes Pedestrian

MOTORISTS who strike pedestrians or other cars and escape before they are identified might drive more carefully in a city that required on all cars a new automatic bumper attachment, invented by E. R. Stump, of Seattle, Wash., and pictured below.

Any sudden impact on a bar that projects slightly ahead of the bumper, instantly short circuits the ignition wiring, stopping the car. Before the driver can start again, he must alight and reset the switch, giving bystanders or an officer ample opportunity to note his license number or question him.

This automatic stopping of the car, it is said, would prevent particularly those accidents in which the victim is dragged a considerable distance.

Seattle traffic officers who recently demonstrated the device declared that if legislation could be passed compelling its use throughout the country it would be practically impossible for a motorist who strikes a pedestrian to escape.



Short-circuiting bar ahead of bumper

Galoshes Tied in a Second by Pulling a Tab

ONE pull on a metal tab ties these galoshes snugly over the wearer's shoes without the need of buckles or other fasteners.

The thumb and forefinger merely pull up the tab, insuring a waterproof and comfortable fastening. Pulling down the tab unlocks the fastening.

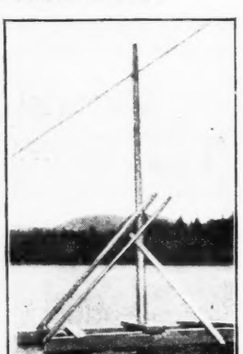
The tab operates by engaging or disengaging specially designed teeth on each side of the opening. The principle is used in a widely known type of tobacco pouch, also on bags and dresses.

Arrow Poison for Insects

TUBA root, which was used by the "Wild Men of Borneo" as an arrow poison, and is still used in the Malay States as a fish poison, is a most effective insecticide, according to recent experiments in England. Experts hope by its use to relieve the shortage of nicotine, the best insecticide known.

Phone Wires Cross Lake on Pontoon Poles

FACED with the problem of running a telephone line across a lake, the fire chief of the Santiam National Forest in Oregon determined to overcome the difficulty.

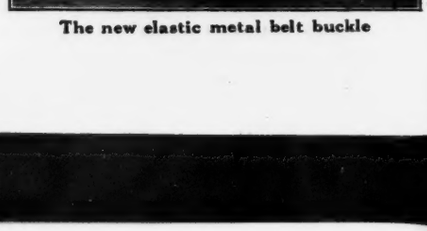


Anchored raft and pole

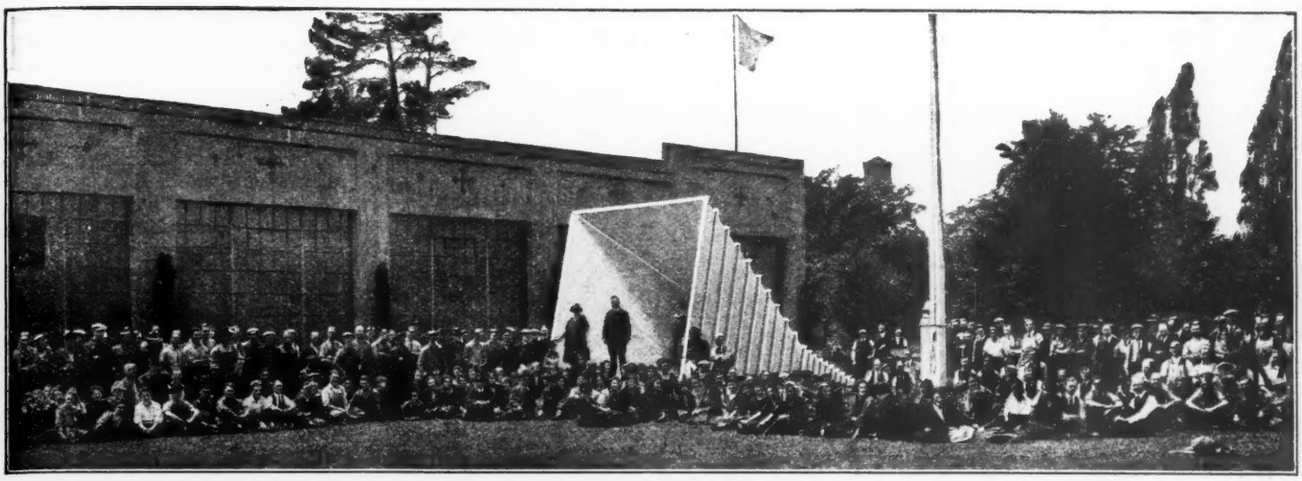
Setting the poles in the lake bottom failed, because the ice pulled them up. He then built log rafts, two every hundred yards, upon which the poles were erected and guyed with diagonal braces. Each raft is anchored with heavy stones and wires.

An Elastic Belt Buckle

TO RELIEVE the discomfort sometimes caused by a belt, a novel elastic metal buckle recently invented gives and stretches according to the strain placed upon it. The usefulness of this feature undoubtedly is noticeable after an especially hearty meal.



The new elastic metal belt buckle



World's Greatest Loudspeaker Can Be Heard Four Miles Away

THE enormous voice of this, the world's loudest loudspeaker, installed at Oakland, Calif., is said to carry music distinctly a distance of four miles, and faintly for even a greater distance.

The great horn is of concrete, and is 12 feet square and 35 feet long. The amplifying device is placed at the throat of the mighty-voiced structure.

Automatic Traffic Signal Has Bell and Lights

BY MEANS of an electrical timing device, a new traffic signal can be operated automatically, or as one of a number of similar signals operated from a central control board.

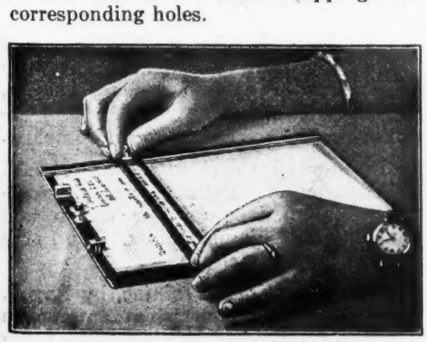
The "STOP" sign swings on a track along one side of the control box. As it swings, red and blue lights alternate, indicating "stop" and "go." A loud gong rings at each change.

The automatic timer and the signal both are motor driven through worm gear.

Writing Aid for the Blind

A DOUBLE guide bar that runs along the side rails of a frame containing letter paper has been devised to aid blind persons to write letters with lines straight and regularly spaced.

The little finger of the pen hand follows along the lower strip of the alining bar. The bar is moved from line to line, a peg at each side of the frame dropping into corresponding holes.



Letter-writing guide for the blind

Engineer's Shovel "Rings Up" Weight of Coal

ENGINEER BILL DECAMP, of the Baltimore & Ohio Railroad, has made it possible for the furnace tender to ring up every load of fuel his shovel thrusts into the firebox. In working out a device for this purpose, he has applied the principle of the cash register of the retail merchant.

DeCamp's invention consists of a counter placed in the handle of the scoop shovel used by the locomotive fireman, as shown above. This counter is operated by the pressure of the weight of coal. Without the weight, the register does not operate, and for this reason the shovel may be used for cleaning up without interfering with the coal record.

Electric Soldering-Iron the Size of a Pencil

A PENCIL-LIKE electric soldering-iron, only eight inches long, has been perfected to simplify home soldering tasks, especially the fine work required in soldering radio connections. It is plugged into an electric-light socket.

The iron, constructed entirely of metal, is fitted with a German silver tip that is said to assure a smooth, clean surface at all times. Eight feet of cord wire is provided. It is protected at the top of the handle by a light metal spring coil that prevents fraying of the wire at this vital point.

Attached to the other end of the cord wire is a plug connection holding a standard electric-light bulb for resistance purposes. This feature offers the advantage of both heat and light without additional operating costs and permits the regulation of the heat.

Two interchangeable tips are provided, one for coarse work, the other for fine work. The lower third of the iron is flexible. The handle never becomes hot, according to the inventor.

Soldering a radio condenser connection

Airplanes to Fly around the World

The map shows the route that the Douglas World Cruisers plan to follow in their attempted flight around the world, starting and ending at Seattle, Wash. At the right is one of the four airplanes especially designed for the trip. Major F. L. Martin (inset) will command the flight of 27,000 miles

A 27,000-mile flight around the world by four U. S. Army aviators—the most ambitious aeronautical adventure ever undertaken—will be in progress by the time this magazine is read. Those in charge hope to accomplish the feat in about four months.

Starting at Seattle, the expedition will skirt the coasts of Canada and Alaska, passing along the Aleutian Islands. From there it will hop to Asia, traversing Japan's possessions southward and coasting the shores of China, French Indo-China, Siam, and Burma. Thence the route will cross India, pass up the Persian Gulf and over Turkey and Europe to England.

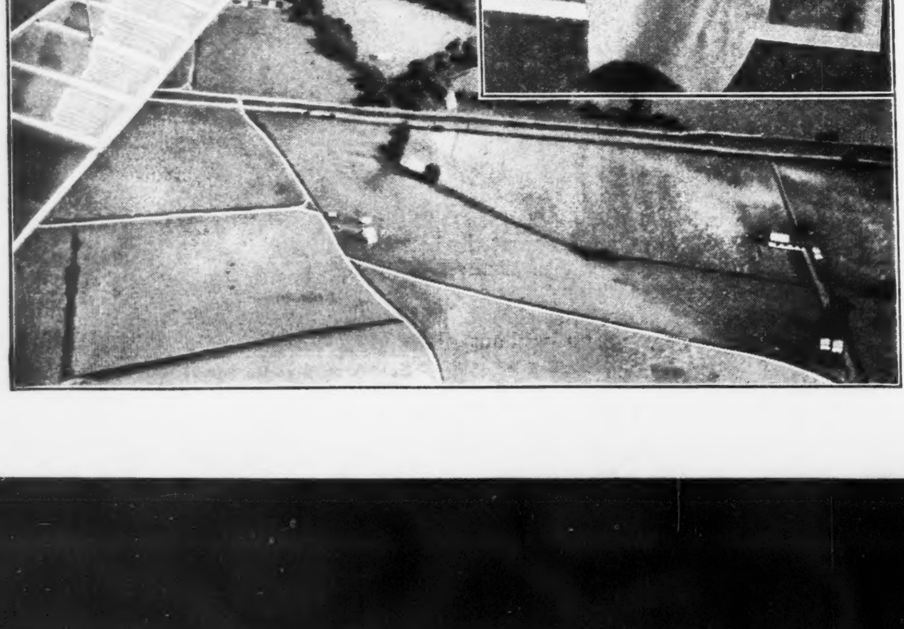
From England the flight will be to Labrador by way of Iceland and Greenland. The last lap will be past Montreal and Quebec to New York, from there to Washington, and back to Seattle across country.

The four planes, known as the Douglas World Cruisers, are entirely of American design and manufacture. Driven by Liberty motors, they travel at an average speed of 105 miles and can make a non-stop flight of 2200 miles.

Airplane Photographs Measure Crop Areas

MEASURING crop areas at the rate of a mile a minute is the latest achievement of the U. S. Department of Agriculture. The fields are photographed from airplanes at altitudes of from 2500 to 7000 feet. By means of a planimeter, an instrument for measuring irregular areas in photographs, the actual area of each field is determined.

Below: Using a planimeter to measure the area of a field shown on a photograph taken from an airplane



Recent Publications

A résumé of new books on science and invention

Science Remaking the World, edited by Otis W. Caldwell, Ph.D., and Edwin E. Slosson, Ph.D. Sixteen illustrated articles prepared by as many distinguished educators and scientific workers and relating the story of the wide range of modern science and its influence on human life. Doubleday, Page and Co.

Stories of Scientific Discovery, by D. B. Hammond. Biographies of a dozen great pioneers of science, ancient and modern. The Macmillan Company.

The New Decalogue of Science, by Albert Edward Wiggam. A journey through the fields of modern science, particularly biology, psychology and anthropology. The Bobbs-Merrill Company.

Phonograph Construction, by E. M. Winterbourne. Detailed, easily understood instructions for the design and building of talking machines. The Bruce Publishing Company.

Automotive Trade Training, by Ray F. Kuns. A comprehensive automobile handbook. Revised Edition. The Bruce Publishing Company.

Queen of Dirigibles Ready for U.S.

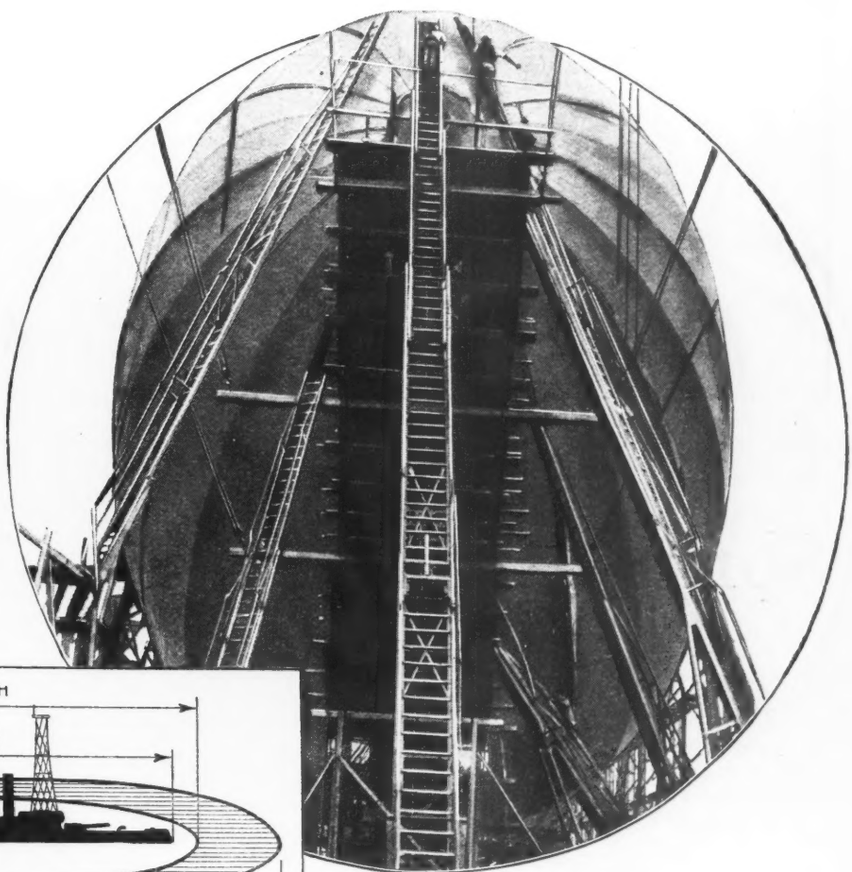
THE monster ZR-3, the United States naval dirigible now rapidly nearing completion at Friedrichshafen, Germany, birthplace of the Zeppelin, is to be sailed home across the Atlantic, some time this spring, by a picked crew of 30 men.

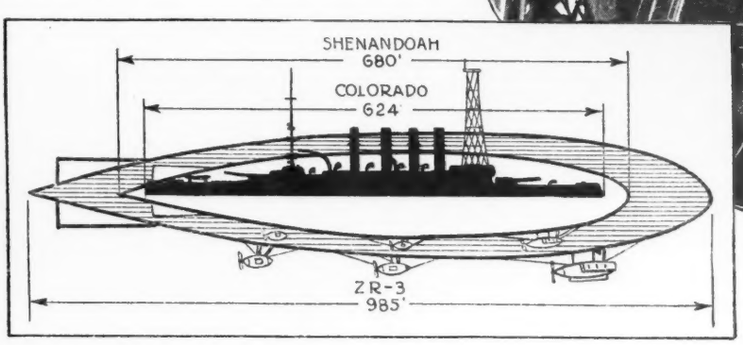
In every way this latest aerial giant overshadows the now famous dirigible *Shenandoah*, formerly the ZR-1. She is 985 feet long and 130 feet high, as compared with the 680-foot length and 96-foot height of the *Shenandoah*.

Her 400-horsepower, reversible Maybach motors will drive her 80 miles an hour. The top speed of the *Shenandoah* is 70 miles.

The tremendous bulks now being achieved by dirigible designers are demonstrated strikingly by contrasting the length of the ZR-3 with that of the battleship *Colorado*, the latest addition to the nation's first line battle fleet. The length of the *Colorado* is 624 feet—only about two-thirds as long as the world's mightiest airship.

The ZR-3 was scheduled to take the air for its first engine tests during the early part of April.





The world's greatest dirigible, the ZR-3, nearing completion for the United States Navy in its hangar at Friedrichshafen, Germany. The diagram at the left shows the huge bulk of the ZR-3 compared with the dirigible *Shenandoah* and Uncle Sam's greatest battleship, the *Colorado*

Amundsen's Polar Flight To Be for Norway

WITH the indefinite postponement of official plans for the transpolar flight of the United States navy dirigible *Shenandoah*, interest is centering in the spectacular attempt of Captain Roald Amundsen and his Norwegian expedition to reach the North Pole and to discover uncharted territory in the Arctic by airplane during the coming summer.

A recent report that Captain Amundsen would recognize a claim by the United States to any new territory he might discover was met by an emphatic denial in a statement by Arne Kildal, official Norwegian press representative of the expedition in America.

"Captain Amundsen declares that he has in no way given his consent to any annexation of such for the benefit of the United States," the statement says, "and that the possession of all the land that he or his expedition may discover naturally will be taken in the name of his Majesty, the King of Norway."

The Amundsen expedition plans to start from Spitzbergen in June, to cross the polar regions, and return by way of Alaska. An American navy officer, Lieut. Ralph Eugene Davison, will be a member of the expedition.

How Much Science Do You Know?

IN THE simplest, most obvious, every-day happenings often lie hidden the most fascinating scientific facts, wholly unknown to you.

The knowledge of one apparently commonplace fact about the hidden forces of nature often becomes a skeleton key to open many doors of scientific understanding, that will stimulate your mind, give you confidence, and win the respect of others.

Read the dozen questions below. Answer them to the best of your ability. Then turn to page 143 and see how nearly you were right.

1. Why do you feel more active on a cold, bright day than on a damp, cloudy one?
2. How do we know that the regions around the North and South Poles once were warm?
3. Why does silver turn black when exposed for a long time to air?
4. Is there such a thing as invisible light?
5. What physical changes are caused by fear?
6. What causes a water mirage?
7. What is the remnant of a third eye inside our brain?
8. Why are white clothes cooler than black ones in the tropics?
9. How did scientists determine the earth's weight?
10. What poison is so strong that a spoonful could kill every one on earth?
11. How do gases, liquids, and solids differ?
12. Are hunches usually right?

The window-sash should be well protected with paint. While one coat covers if a dark color is used, two coats are necessary for a paint film that will withstand the weather

The simplest way to stipple a painted wall. The second, contrasting color is applied with a damp sponge, which is cut with scissors to produce the desired design for the stipple

If yours is a shingle house, or if its body color is dark with light trim, the house can be freshened up by giving the trim a coat of paint, which also serves to protect the wood

Spring Painting—Inside and Out

By N. M. Collart

This is the time of year when the thoughts of householders turn naturally to painting. The winter has left its marks on the outside of your home. Here and there the paint that looked so well last autumn has faded. Perhaps it has even disappeared, leaving areas of bare wood.

Or it may be that inside the house the walls, floors, ceilings, woodwork, and furniture are showing signs of wear and tear.

Do you know how to go about removing these unsightly danger spots with paint? In the accompanying article, N. M. Collart, a nationally known expert, describes how the amateur can perform almost every conceivable sort of painting job.

PAINTING—to a person who never has done any—probably appears to be the simplest work in the world. In a way, that is correct. The mere act of dipping a brush into a can and covering a surface *can* be done in a more or less satisfactory manner by any one after a little practice. But *real* painting, that will provide protection, decoration, and a surface that won't peel, crack, blister, discolor, or otherwise show signs of wear before its time—that is a different matter.

Real painting depends almost entirely on using the right kind of paint, especially for the first, or priming, coat. Given the proper paint for a particular job, there is no reason why the ordinary man or woman, with a little care, shouldn't turn out a job that would do credit to a professional.

When you consider that three coats of paint make a film only 8/1000 of an inch thick — about as thick as a sheet of writing-paper—it is obvious that to give proper protection your paint must contain the best materials, and that the various ingredients—pure raw linseed oil, pure turpentine, dryer, and pigment—must be mixed in correct proportions, according to the kind of wood it is to cover.

IN THIS connection I recall the experience of a friend of mine who sought my advice in repainting his house not long ago. The original painting job had been unsatisfactory. What bothered him most was the fact that the paint had peeled from some parts of the house and not from others.

I soon found the reason. The trim was of white pine, while the walls were of cypress siding. On the pine the paint had stayed firm, but it had peeled from the cypress. This was quite natural, considering the kind of paint used in the original job.

Pine is a normal wood, which takes and holds paint well. If the knots are well shellacked before painting to prevent pitch from "bleeding" through, any good paint applied to pine with ordinary care gives a serviceable job. Cypress, though, is very oily. If a primer suitable for pine—that is, a primer rich in pure raw linseed oil—is used on cypress, as was the case on my friend's house, it will not penetrate the wood, but will dry more or less on the surface. Then, when the paint film becomes hard, it loses its elasticity, tending to chip or peel off.

If floor boards have shrunk so as to leave unsightly cracks, the remedy is to force paste filler into the cracks with a knife or with the thumb, after the first coat of paint has been applied. Allow the filler to dry thoroughly before applying the second coat

I advised my friend to prime his cypress walls with a mixture of two quarts of pure turpentine and a quart of linseed oil to a gallon of ready mixed paint. The turpentine penetrates the cypress, carrying the paint with it and providing a groundwork on which the top coats can be spread smoothly and more or less permanently.

Had the siding been redwood, cedar, or some other porous wood, I should have advised him to make his primer of a gallon of pure raw linseed oil, a quart of turpentine, and a gallon of paint. This oil would satisfy the natural absorption of the wood, and prevent the wood from robbing the top coats of their oil. For the top coats the paint should be applied just as it comes from the can.

THE most important part of all painting is priming, putting on a correct first coat; for if the primer lets go, off come the top coats as well. A simple rule to follow is to use plenty of turpentine for oily woods and plenty of oil for spongy woods.

I also pointed out to my friend the danger spots about his house—the places where especial care is necessary in painting. Chief among these is the porch. The porch floor and steps really should be painted every spring, for they are a ready prey to the weather.

The base of wood columns should be puttied tightly and well painted to prevent water from settling underneath and rotting the wood. Joints on railings and window-sash likewise afford entry places for water and decay, unless kept well painted and puttied.

The bottoms of outside doors are hard to get at, but, if these are not painted, the

doors are likely to take up moisture and to swell and stick.

In all of this work my advice is not to economize on either paint or brushes. Buy the best. A few extra dollars spent on good paint and good brushes will save many dollars in carpenter's bills.

There are so many kinds of interior painting that it would be impossible to describe them all in detail here. For woodwork, the full varnish finish—the "piano finish"—undoubtedly is the goal of most persons in decorating their homes. And most persons fall short of this goal simply because they do not precede the application of varnish with sufficient sandpapering and because they fail to keep the surface free from dust and dirt.

A CLEAN brush is absolutely necessary in varnishing. Before starting work, wash the brush in a mixture of linseed oil and turpentine, and squeeze dry. After this, pour out about half a cupful of your varnish, dip the brush into it and scrape it over the edge of another cup. By the time the varnish has been transferred from the first cup to the second, the brush will be clean enough for use.

Brush on the varnish freely and quickly "with" the grain of the wood. Then, without dipping the brush into the varnish, "lay off" the surface by brushing straight across the grain. This spreads the varnish to an even thickness and covers any spots you may have missed the first time. Finally the surface is "straightened out" by brushing once more with the grain.

To obtain a dull finish, surfaces having a glossy finish may be rubbed with powdered pumice-stone and rubbing oil, or sewing-machine oil. Make a pad of soft cloth and wet it well with oil. Dip this into the saucer holding the powdered pumice-stone and rub the varnish with a light, steady, even pressure, always "with" the grain. A dozen strokes back and forth may be sufficient to produce a dull finish. As a last step, wipe the surface dry with a soft, clean cloth.

DULL-DRYING varnish also may be used to obtain a dull finish. The surface should be rubbed lightly with No. 00 sandpaper before the varnish is applied, to cut the gloss. Dull-drying varnish is particularly useful in conjunction with staining, preserving the natural "woody" look and texture of the surface—"weathered oak" and "fumed oak," for example. This finish is practical and durable.

Varnish-stain, which, as its name implies, serves a double purpose, is applied easily, and for that reason appeals strongly to the amateur wood-finisher. Through its use the old golden-oak piece that you have been considering discarding can be disguised as walnut or mahogany and earn a place with your best modern furniture. The furniture should be wiped off well with gasoline or benzine, and rubbed with sandpaper before the varnish-stain is used. I have seen good graining effects produced in conjunction with colored varnish by drawing an old whisk broom through the varnish before it had set.

Enamel must be "built up." That is to say, the surface you are to enamel must be covered first with a solid, opaque paint called "enamel undercoater." For best results, this undercoater should be tinted to match the color of the enamel. Enamel should be applied in a warm room and brushed on exactly like varnish. An ordinary bristle brush is too stiff and coarse, and will leave brush marks. To avoid these a good fitch or oxhair brush should be used.

Floors must be refinished occasionally. Hardwood floors may be treated either with varnish or shellac. Shellac dries quickly, but is rather expensive. It is

The right way to varnish or enamel a chair: After wiping it clean, hold the chair upside down, painting the legs first. This not only affords an easy means of holding it, but leaves the top—the most important part—to be painted last. Don't be afraid to brush out the varnish well, to avoid "runs"

brittle and will discolor if wet with water, though some people prefer it because pure white shellac does not darken the wood or otherwise change its appearance. Good floor varnish is tough, waterproof, will not scratch white and usually is pale enough not to alter the color of the wood or linoleum.

When you have made your choice between varnish or shellac for your floors, stick to it. Never lay on a first coat of varnish and finish with shellac.

If your floors are oak, they will require filling with a *paste* wood filler before refinishing, since oak is an open grain wood. Floor varnish should be applied exactly like furniture varnish—freely and quickly with the grain, then "laid off" across the grain and "straightened out" by brushing once more with the grain.

Old floors of soft wood can be made attractive with paint, or they may be treated with varnish stain by the method described for furniture. Should the floor boards be badly shrunk, the cracks must be filled with paste filler after the first coat. Brush the first coat well down into the cracks; otherwise the wood may dry out the filler and cause it to loosen and come out.

The processes I have described may be applied to interior trim, doors, shutters, steps, banisters, railings and so on, according to their original finish or the finish desired.

With a little paint and trouble, your cellar can be made quite as attractive and habitable as any other part of the house. Two coats of concrete paint, which can be obtained in a variety of colors, not only will bring an end to the cement dust that collects on your cellar floor, but will make the cellar bright and cleanly. Before applying this paint, wash the cellar floor with a hose and let it dry thoroughly.

ALUMINUM paint will give a durable finish to your furnace, water boiler, and water pipes. It is a good plan to identify your piping system by painting hot water or steam pipes red, cold water pipes blue and gas pipes green. Cold water paint on the walls also will add to the attractiveness of the cellar.

Painted wall finishes recently have become popular, particularly the stippled effect resembling high grade wallpaper. Stippling can be done easily. A background or foundation color of some flat wall paint is applied and permitted to harden. Over this is printed a contrasting color of paint that is rolled or crumpled while still wet by patting with a wad of newspaper or cloth, applied with a light twisting motion of the hand.

ANOTHER way of producing this effect is by applying the contrasting color with a damp sponge. The paint is rubbed onto a board or newspaper, from which it is taken by the sponge and "printed" on the wall, the sponge reproducing its own texture in the contrasting color. It is well to make several test prints before applying the paint to the wall, trimming the sponge with a scissors until you have obtained a suitable design. The selection of colors for stippling, of course, is a matter of personal preference, but it is advisable not to make too harsh a contrast between the background color and that selected for stippling.

In this brief survey of home decoration there are two materials I have not mentioned, although no painting job can be finished successfully without them. You alone can supply them. They are Care and Patience.

The beauty of ivory or French gray enamel furniture is brought out simply by color striping and using unit stencil patterns, as shown above. Afterward, you can put in by hand a few touches, such as stems, buds, and high lights not in the original pattern

WITH summer comes a host of adversaries to attack your backyard garden that has looked so promising all spring. Chief of these are weeds and insect pests. How to get the best of them before they get the best of you, will be told in an early issue by Ernest Bade, Ph.D., who in the March issue offered valuable suggestions for spring planting.

A Universal Radio Tuning Unit

How to Make a Combination Inductance for almost Any Hook-Up

By Joseph Calcaterra

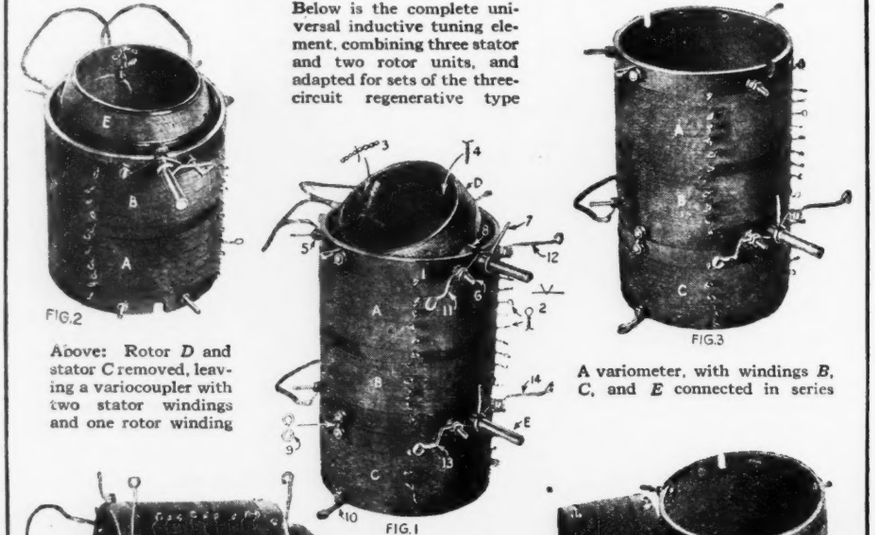
Radio Editor of Popular Science Monthly

IN EXPERIMENTS to develop a means of eliminating the usual waste of time, energy, and money in the construction of various types of radio tuning elements for use in the various types of hook-ups, the POPULAR SCIENCE MONTHLY radio laboratory has evolved the novel universal instrument pictured on this page. Combining the essential characteristics of all the most commonly used inductive tuning elements, it can be adapted, with slight variations in arrangement, to the requirements of almost any type of standard radio receiving set.

In addition, it embodies the simplest method of rotor mounting yet devised, as well as the simplest way of mounting the coils to the base of the receiving set.

In this article I shall endeavor not only to describe how this unique combination unit is assembled, but to offer general suggestions for the construction of tuning elements that may be of assistance to the man who builds his own receiving set.

Referring to the illustrations on this page, Fig. 1 at the center is the new universal instrument, with three stators and two rotors combined to form a tuning element for use in powerful and selective receiving sets such as the three-circuit regenerative receiver. Here one rotor would be used for tuning the secondary, and the other rotor for tuning the plate circuit.



Below is the complete universal inductive tuning element, combining three stator and two rotor units, and adapted for sets of the three-circuit regenerative type

FIG. 1

FIG. 2

Above: Rotor *D* and stator *C* removed, leaving a variocoupler with two stator windings and one rotor winding

FIG. 3

A variometer, with windings *B*, *C*, and *E* connected in series

FIG. 4

Left: Double rotor tuning element, with coil *C* removed. Right: With two rotor windings removed, coil *C* at right angles to *A* and *B*, form a Cockaday coil

FIG. 5

IN FIG. 2, rotor winding *D* and stator winding *C* have been removed, leaving a variocoupler with two windings on the stator and a rotor winding. This could be used in a circuit with winding *A* serving as the primary, *B* as the secondary, and *E* as the tickler coil. If desired, the rotor winding may be placed at the other end of the stator tube, so as to place it closer to the larger winding, *A*.

In Fig. 3, the unit is converted into a variometer. In this case, windings *B* and *C* are connected in series to form one continuous winding. One end of the stator winding then is connected with one of the rotor leads, leaving one rotor lead and one stator lead.

In Fig. 4, the unit has become a double rotor type of tuning element, with coil *C* removed. The two windings *A* and *B* can be connected in series and used as the primary windings, and windings *D* and *E* as the secondary and tickler-coil windings respectively. Another arrangement is to use *A* as the primary, *D* as the secondary, and connect coils *B* and *E* in series to act as a variometer in the plate circuit.

In Fig. 5, the two rotor windings are removed. The coil winding *C* is fastened to the main stator tube by means of the connecting link screws so that the axis of coil *C* is at right angles to that of the other windings, and the unit serves as a Cockaday coil. It is necessary only to connect one turn of wire around coil *A* and connect this turn in series with coil *C* to serve as the primary coil of the circuit. Coil *A* forms the secondary coil winding, while coil *B* is used as the absorption circuit coil.

Many other combinations are possible with this unit. As you experiment with the coil, these will suggest themselves to you.

In constructing a tuning element, the manner in which you make the windings, the taps, rotor bearings and the other constructional details is extremely important to the ultimate success of the completed tuning element.

A four-inch tube is the best size to use for stator windings. The diameters of most of the standard rotors vary from 3¼ to 3½ inches and can be used to best advantage with a tube of this size.

The simplest and most efficient arrangement for the taps is a straight line, running the length of the coil and approximately 1½ inches to the side of a line projected along the length of the coil from the rotor bearing. This will bring the taps within easy reach of the switch points with which they are to be connected.

It is a good idea to have two sets of taps, one set on each side of the center line of the winding as shown in the photograph. The winding is started on the left-hand side of the coil about 1½ inches from the center line, as shown at 1. At a point about 1½ inches to the right of the center line, another tap is taken. The winding is continued for 10 turns and a tap taken at a point at the left directly below the beginning of the winding. On the same turn, but to the right of the center line, another tap is taken.

This method is followed all the way down to the end of the winding. The last tap at the end of the winding is taken at the right-hand side of the center line, completing the two sets of taps, one on each side of the center line.

The advantage of this method lies in the fact that the switches can be used on either side, a very important consideration in experimental work.

For all general purposes and for experimental work, I have found that 50 turns on the *A* winding, 40 turns on the *B* winding, and 40 turns on the *C* winding, each tapped at every 10 turns, give best results. The rotor windings of *D* and *E* should have about 35 turns, although for various uses, other rotors with a larger or smaller number of turns can be substituted easily with the type of bearing used in this unit.

THE distance between windings *A* and *B* is one-quarter inch. To determine the length of tubes to use, it is necessary to know just how long the windings will be. This can be determined very easily when it is known that 33 turns of No. 22 s.c.c. or d.s.c. wire will make a winding length of one inch. If No. 20 wire of either insulation is used, approximately 26 turns will make one inch; while if a smaller size such as No. 24 is used, as many as 40 turns can be wound to the inch.

Since wire is sold by the pound or fraction of a pound, it is necessary to know what weight of wire to ask for to make a

(*Continued on page 139*)

How to Select Your Radio Parts

One Defective Unit Will Spoil the Best Hook-Up

By Jack Binns

America's Most Popular Writer on Radio

A RADIO set is no better than the poorest part in it!

This is as true as the fact that no chain is stronger than its weakest link. No matter how well a receiver may be designed, constructed, and wired, it never will function satisfactorily if one defective part is employed in it.

That is why the problem of selecting radio parts is one that sorely perplexes not only the fan who builds his own receiver, but also the one who buys a factory-made product. The questions I hear most frequently are, "Which are standard parts?" "What defects must I look out for?"

I am going to try to answer these questions this month by pointing out the good points and the bad points to be considered in choosing various pieces of apparatus employed in a receiving set.

AT THE outset we must bear in mind that the science of radio still is in a state of flux. Consequently there is no such thing as standardization at present, though serious efforts are being made by responsible organizations to develop a system of standard quality for the industry.

Let us take the receiving apparatus step by step, and consider what characteristics are necessary to insure maximum efficiency in operation. First of all, the aerial. This should be of copper wire. Whether it is of single or multiple strand makes little difference, so long as it is copper. The stranded wire will offer greater mechanical strength with less likelihood of breakage under strain. The copper may be tinned to prevent corrosion from exposure.

The aerial is a very important part of the radio set, and unless it is correctly erected, maximum results are impossible. No matter what form the aerial takes, it should be kept free of all kinks or bends. The straighter the wire, the better the results. It should be free of straggling ends, such as might result from two or three ruptured strands.

If possible, keep the wire in one continuous piece from one end to the point where it is actually attached to the receiving set. If a joint is necessary, be sure that it is well soldered to prevent resistance at the point of the joint. Remember that the amount of energy picked up by the aerial is very small, and that it is unwise to lose any of it through the want of a little care.

The type of strap "lead-ins" that have appeared recently should not be used. These offer possibilities of too much leakage. A tube should be used. It should be of good insulating material, preferably porcelain, and it should be long enough to keep the wire clear of any other objects, metal or otherwise.

Careful examination of radio parts before purchase, judging them by the points outlined by Jack Binns in the accompanying article, will save trouble when the set is completed

THE ground connection should receive equal care. A water pipe offers the best means, but remember that every "elbow" in the water-pipe system offers resistance to the high-frequency currents. It is best to run a ground wire down to the cellar, wherever possible, and make the connection with the pipe at a point just before it leaves the house. The pipe should be scraped clean with a file and a firm mechanical and electrical contact made with it. A ground clamp may be used, but it is a good plan to solder the connection in addition.

The actual parts to be used in the radio set are the next consideration. Whether it is better to buy a completed set, or construct one, always depends upon the individual and his skill with tools. The points which I shall emphasize will serve as a guide in either case.

First of all are the various forms of inductances. These always are coils, although they may take many different forms. They may consist of variocouplers, variometers, or duolateral and honeycomb coils. The important consideration in all inductances is the amount of distributed capacity in the windings. This always should be at the minimum. The duolateral-wound coil is an example of low distributed capacity in a coil, due to the particular form of winding.

IN A variocoupler such winding is impossible. The point to watch for in this instrument is the use of sticky material to hold the coils together. None should be used. Double-covered wires necessarily must be used, but it is not necessary to dope them. The single-turn taps on the outside coil should be so arranged that they run diagonally across the coil, thus preventing short-circuiting of the turns at the points where the taps are made. Where variable condensers are employed in conjunction with the primary winding of a variocoupler, individual tapping of the turns is unnecessary.

In the rotor coil of a variocoupler, flexible connections to binding-posts should be widely separated from each other. This means, of course, that the rotor should move around only 180 degrees. Do not consider couplers where the rotor connections are made to the shaft on which the coil revolves. This involves a friction contact that always introduces resistance into the radio-frequency side of the circuit.

The insulating material on which the coils of the coupler are wound, should be as thin as possible consistent with mechanical strength. In other words, too much molded material is detrimental to maximum results. The same care should be exercised in choosing variometers. Pigtail (flexible wire) connections are necessary between the rotor and stator coils, and while it is necessary to have a certain amount of "dope" on the coils to hold them together, the least possible amount should be used. Collodion is the best material. The smaller the amount of insulating material in the forms holding the coils, the better the variometer.

Remember that in both variocouplers and variometers the wave-length range will depend entirely upon the amount of inductance in them. The inductance, in turn, depends upon the size of the wire used, and the number of turns employed. The wire should be no smaller in gage than No. 30. A larger diameter wire will give better results.

The ideal variable condenser still remains to be produced. In no other instrument is there so much loss. The most efficient type is one with a minimum of insulating material between the rotor and stator plates. Here the stationary plates are fastened to narrow strips of special hard rubber, which are well away from the rotor plates. The latter are part of the main frame of the condenser, and they have a flexible connection with a binding-post screwed directly into the metal frame. The condenser is fitted with stops so that more than 180 degrees of movement is impossible.

MOST variable condensers at present employ aluminum plates, but unfortunately it is very difficult to get absolutely positive electrical connections with aluminum. Brass plates are better, but they should be very thick so that they cannot get out of alinement. The plates should be soldered together both in the rotor set and the stationary set. A separate Vernier plate always is bad, because losses are introduced in the bearings. It is much better to employ some good form of Vernier attachment on the dial controlling the condenser.

Fixed condensers appear to be simple little instruments, yet in them lurks all kinds of trouble, unless they are constructed with the greatest possible care.

Under no circumstances should a fixed condenser employ paper as the dielectric. This type of condenser is cheaply made as a rule, and the paper and foil are wound around a piece of fiber. The capacity of such an instrument is changing constantly because of varying conditions around it. This is because the pressure between the foil and paper is not constant—a defect that may be responsible for many noises in a set. Placing a paper condenser in any part of the circuit where it crosses a high-voltage B battery is a dangerous practice.

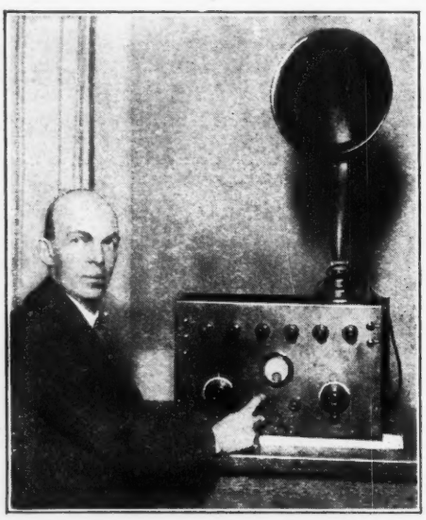
The ideal fixed condenser is one using a dielectric of mica, and held between two covers that have been forced together under extreme pressure, and finally sealed off, so that a variation in the pressure is impossible. Only in this manner can constant capacity be assured.

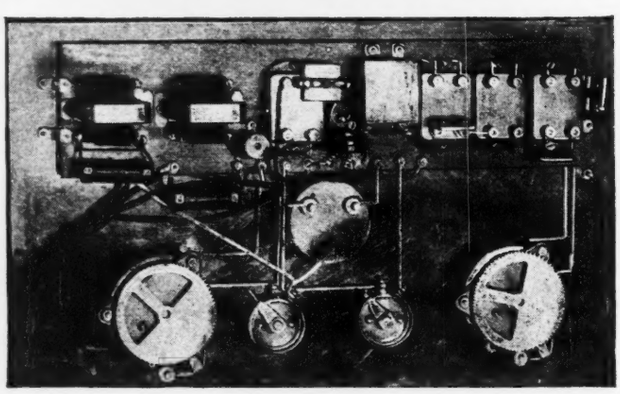
In choosing sockets, make sure that the springs are sturdy and will not bend. Steel cannot be used for the springs, but good phosphor-bronze will serve well. The binding-posts to the springs should be separated as far as possible, and the socket should have as little insulating material as possible in order to reduce capacity losses.

Rheostats are very important instruments. They not only regulate the voltage and current flow to the filaments of the vacuum tubes, but they also dissipate heat. If they are overloaded—that is, if too many tubes are run off one rheostat—the wires will heat up dangerously. The resistance wires should be wound on heat-resisting fiber, and should be arranged so that they offer a good surface for radiating the heat. The contact arm that passes over the resistance wires should rest firmly on the wire at every possible setting. Unless it does, an arc will be formed at the point of contact, burning out the rheostat.

The selection of transformers offers a very difficult problem indeed. Little can be said about radio-frequency amplifying transformers, because their results are so problematical, except in the most carefully studied circuits. In my opinion they are not the ideal form for radio reception. No standard can be set as a guide in their purchase. Any radio transformer for which sweeping claims are made as to wave-length range should be shunned.

In audio-frequency transformers a similar condition prevails. But here a very good guide is the step-up ratio of the transformer. This should not exceed five to one. A three-to-one ratio transformer, well constructed, will give all the amplification necessary for good results without possibility of distortion or the setting up of audio-frequency howls.





The Latest Development in Radio

MAJOR EDWIN H. ARMSTRONG, pioneer radio inventor, is seen in the upper picture demonstrating the last word in radio development—his newly designed receiver known as a "second harmonic regenoflex super-heterodyne." The layout of parts of the new receiver appears in the lower picture.

Major Armstrong describes his set as depending not alone on radio-frequency amplification, audio amplification or regeneration, but makes use of a third frequency known as "intermediate frequency." This is said to be higher than audio frequency and lower than radio frequency as used in present receivers. The combined use of the three frequencies is said to give an over-all amplification of great magnitude, making the set extremely sensitive. Radiation is eliminated by use of a special muffler tube circuit. Six tubes of the UV-199 type are used in operation

The iron core of the transformer is an important part of the instrument. It should consist of fairly thin-gage soft-iron laminations, arranged in a completely closed magnetic circuit. The binding-posts with which connections are made should be well insulated, and it is a good plan to test the transformer for continuity of the primary and secondary windings before purchasing. Be sure, too, that neither of the two windings is short circuited to the iron core.

Probably there is no more simple piece of apparatus in a radio set than the grid leak, yet nothing can wreck a receiver more quickly than an imperfect leak. If a variable leak is used—and there are many advantages to such a leak—it should give an even variation in resistance over its entire scale. In the compression type of leak, be careful that the material that is put under pressure to reduce the resistance is not loose, otherwise the reception always will be noisy.

ANOTHER method of varying the grid input circuit of a detector tube is the employment of a variable condenser of the compact mica type. In this case a fixed grid leak can be used, but it is always best to experiment with different values of fixed grid leak, to select the one best suited to the particular tube. The variable grid condenser, if it is of the mica type, should be constructed firmly. Looseness in the movable part always will cause noises in the set.

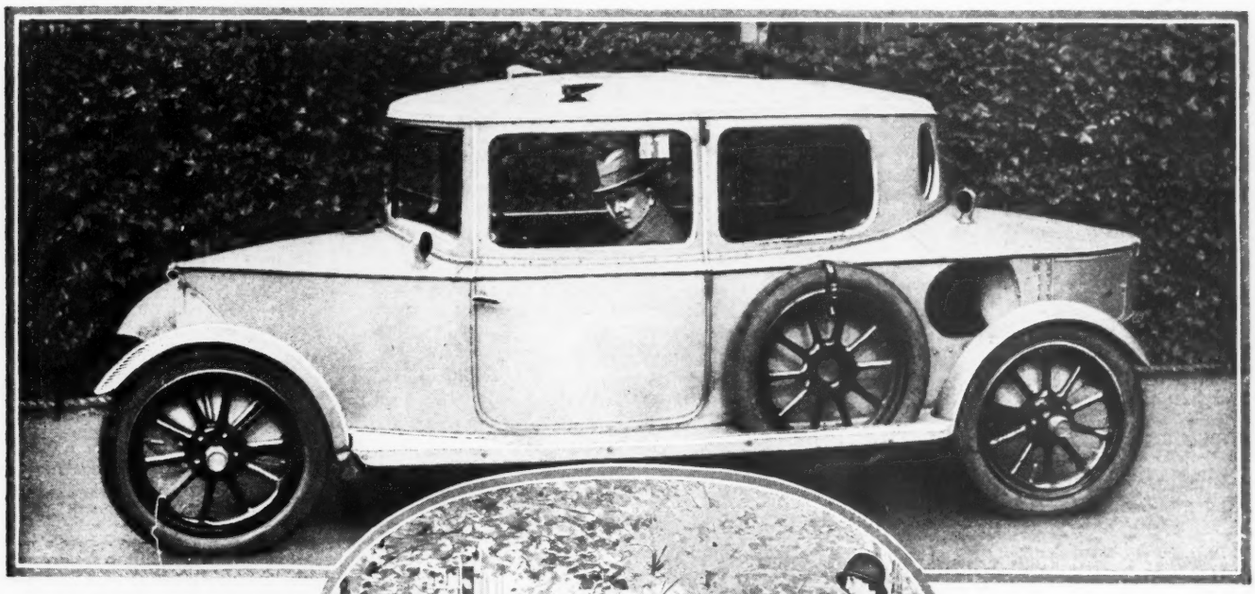
Of the auxiliary apparatus used in a receiver, there is no more useful part than the jack. With it various circuit combinations can be obtained in a second without changing any wires or interfering with the set. There are many different kinds of jacks, however, and imperfect ones may be responsible for many radio ills.

The main thing to look for in a jack is the quality of the contacting springs, which should be strengthened by shorter spring leaves. In addition, in the multi-circuit type, be sure there is perfect positive contact between the springs when the telephone plug is pulled out. Since large voltages will be placed in the jack circuits, the contact points should be fairly large.

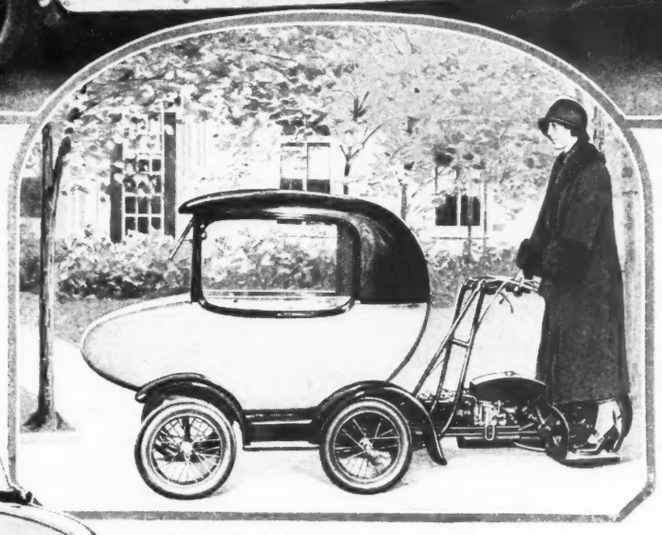
The value of a telephone plug can be judged by close examination. See that the insulation material surrounding the plug is strong. The internal arrangement should be such that the telephone tips are firmly gripped in whatever manner they are engaged. The central rod inside the outer sleeve of the plug should be well insulated throughout the length of the plug, as well as at the point where it enters the handle.

NEXT month—"Radio by the Roadside." Jack Binns will tell how to get the most radio enjoyment during your summer auto-camping trip. His unusual article will give useful pointers for successful reception out of doors, such as favorable locations, erection of an aerial, and choice of a receiver.

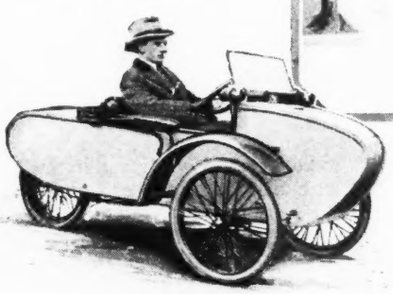
The Latest Oddities in Motor Cars



One of the newest models in the development of the popular small car in England is this four-passenger, streamlined coach. A five-cylinder air-cooled radial engine mounted at the rear is said to give the car unusual power, while economizing in expensive fuel

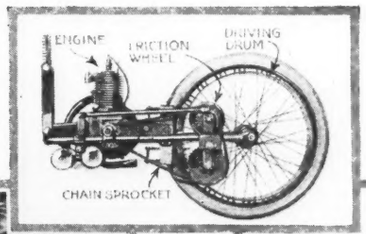


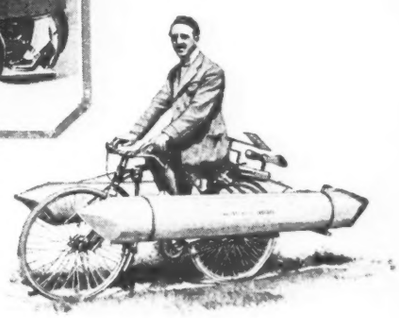
An unusual feature of the powerful small car pictured above is that the body and the chassis are made all in one piece. Each of the four wheels is sprung separately. Engine and transmission are welded to a bulkhead back of the rear seat



This inexpensive monocar has a single rear drive wheel, driven by a motorcycle engine, as shown at the right. Chain sprockets drive cork friction wheels against a drum

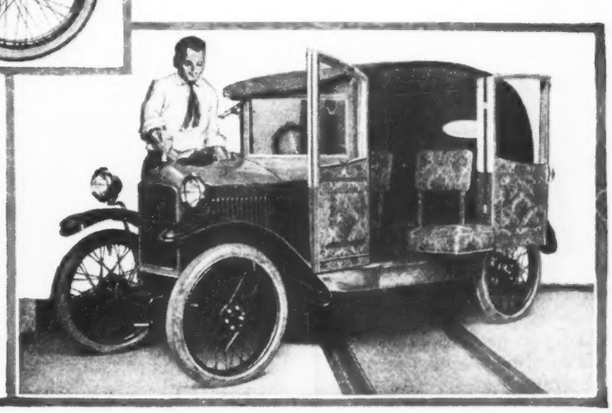
Even the baby can have a car of its own! A streamlined perambulator sedan, recently exhibited at a London auto show, is operated by mother or nursemaid, who stands on a rear platform behind the engine





A motor bicycle that runs on land or in the water is equipped with pontoons, one on each side. In the water, the pedals drive a small propeller. The handlebars control a rudder back of the rear wheel

A number of taxicab operators in Paris, seeking to economize, have adopted the sturdy little taxi shown above to accommodate the many single-passenger fares



Luxuriously upholstered in French tapestry, this seven-horsepower, 850-pound baby sedan is a replica of a high-powered and much more expensive limousine

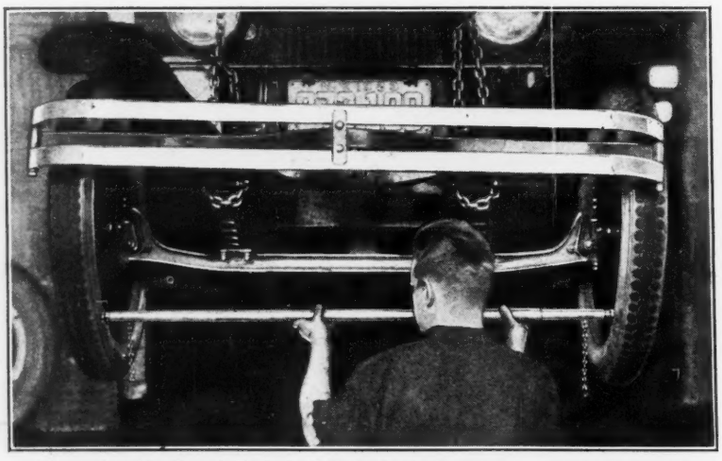
Look to Your Steering-Gear!

The Most Vital Point of Your Car Is the Most Neglected

By F. A. Platte
Department of Physics, Columbia University

MOST motorists have experienced the feeling of helplessness that comes when a car skids suddenly on a slippery pavement. But there is another way in which your car may get out of control that contains more dangerous possibilities than skidding. That is to have your steering mechanism go wrong while you are driving. Imagine yourself proceeding at 35 or 40 miles an hour along a narrow road flanked by a ditch or a wall of rock and consider what might happen were you suddenly unable to steer your car!

And yet I venture to say that the steering mechanism, despite its obvious importance, is the last unit in your car to which you think of giving care and attention.



Measuring the "toe in" of the front wheels to assure correct alinement

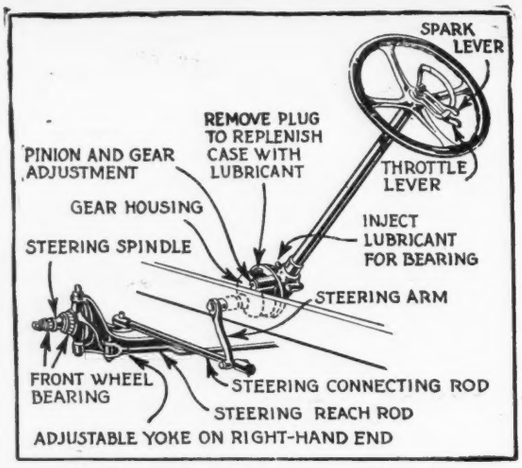
ON A motor car the axle is immovably attached to the chassis, and the wheels are pivoted to the ends in such a way that each can be swung to right or left in the following manner:

When you turn the steering-wheel you revolve a shaft known as the "steering column." At the bottom of this in most types of car is a worm gear. This turns a gear wheel that moves the "steering arms." The arms are connected with the pivoted ends of the axle, which are called the "steering knuckles." These are connected by a cross piece called the "tie rod," and when this is moved from side to side, the wheels turn to right or left.

Each part represents a separate and distinct point where the steering mechanism can get out of order. For example, if a steering-arm breaks, or becomes disconnected from the tie rod, one wheel may swing sidewise and cause the car to go off the road. A similar break may cause both wheels to swing loose on their pivots.

You can insure your car against this sort of accident by a little intelligent care. The most important consideration probably is lubrication. The tie rod and the steering-rod should be inspected and oiled thoroughly every hundred miles. When you are oiling them, look carefully for loose nuts or cotter-pins.

The steering column likewise requires frequent lubrication. It is well to oil the steering mechanism thoroughly whenever the steering becomes especially hard. In all likelihood it will be found that it is due to a dry joint somewhere.



This diagram shows important parts of the steering mechanism that should be lubricated frequently

The front wheels of an automobile are bow-legged and pigeon-toed. In other words, the wheels are not set parallel. They are about a quarter of an inch closer together at the front than at the rear and the bottoms are from a half inch to three inches closer together than the tops. The wheels are made to toe in to compensate for a tendency to turn out in front when the car is proceeding at good speed.

As the car is used, the tie rod wears and the toe-in becomes wider. Finally the wheels begin to wabble. Wear on the tie rod can be reduced to a minimum by frequent lubrication. This is important, since misalinement of the wheels makes steering difficult, causes danger, and is very hard on tires. The wheels may be alined properly with reference to toe-in by adjusting the tie rod.

It is well to test the alinement occasionally. To do this, jack up the front of the car, turn each wheel and, while it revolves, hold a pencil supported on a block against the center of the tire. This will make a mark clear around each wheel. Then let the car down and measure the distance between the pencil lines in front and in rear. Auto mechanics often use a special adjustable measuring-rod for the purpose. The difference between the measurements will determine the adjustments.

ON MOST cars the tie rod screws into a yoke at either end. By unbolting the yoke and screwing it off one or two threads, you will compensate for wear and restore the original toe-in.

The gear wheel turned by the worm in the steering column likewise requires occasional attention. Even when you turn the steering-wheel as far as it will revolve, the worm will engage only three teeth in this gear, and the result is that the gear will be worn excessively at one or two points. You should inspect the gear at intervals, and, if a few teeth show signs of wear, the gear wheel should be turned so that a new set of teeth will come in contact with the worm.

These adjustments the average car-owner can make himself. A motorist's time cannot be employed to better advantage than in keeping the steering mechanism in order; for if the steering gear goes bad, the consequences are almost certain to be serious.

Know Your Car

Here are the most common tire troubles, their causes, and the remedies:

Sand Blister—Dirt works through a hole and under tread. Inspect tires often and repair all small cuts.

Worn Tread—Wheels out of line; sliding tire; driving in car tracks. Adjust the steering knuckle. Don't jam brakes.

Chafed Tires—Scraping against curbs; driving in ruts and car tracks. Use shock absorbers on rough roads. Avoid ruts.

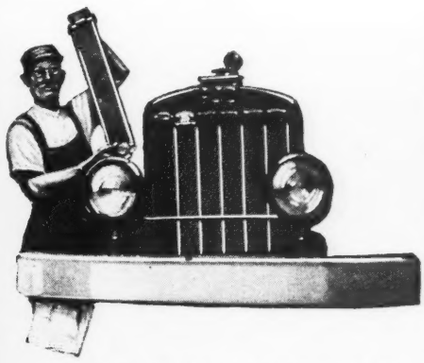
Cut Tread—Glass, nails, and sharp stones. Inspect tires often. Watch the road for glass. Cement cuts wherever discovered.

Rim Cuts—Running on flat tire and skidding. Carry a spare tire. Keep tires well inflated. Take corners slowly.

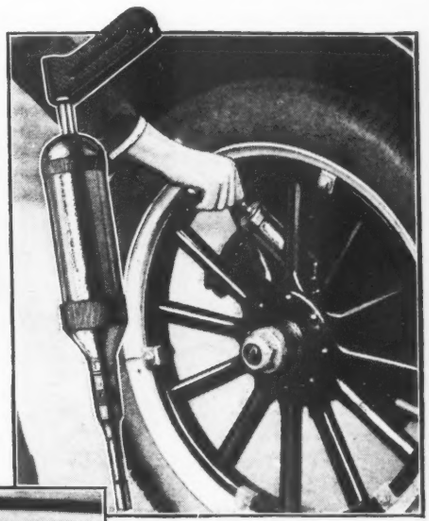
IN NEXT month's issue —the most interesting and unusual automobile camping story ever published. Don't miss it!

New Accessories for the Autoist

A "hot-water bottle" for the auto engine, this new lamp keeps it warm during cold nights, facilitating a quick start in the morning



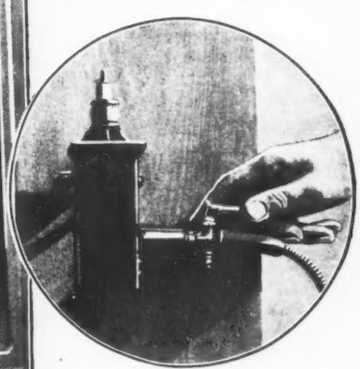
A radiator built in six sections permits replacement of damaged units without the expense of a whole new face. Exceptional cooling capacity is claimed for the special spiral core construction



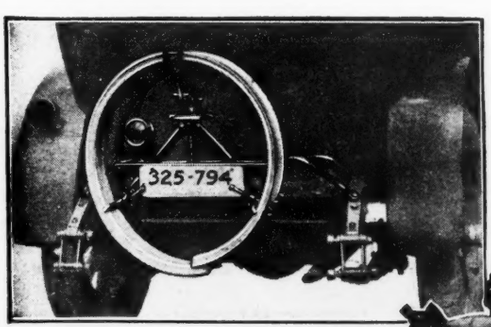
Pressure of 5000 pounds a square inch is claimed for this lubricating grease gun. Pushing the handle forces the lubricant out as needed

This combination gasoline gage, lock, and warning signal automatically shuts off the flow when only one gallon is in the tank. The flow can be shut off at will

During a long trip, one problem is to find an out-of-the-way place to put your hat. The spring hat racks shown above are designed to meet this need. The crown of the hat is inserted in a wire ring that presses the brim flat against the car roof

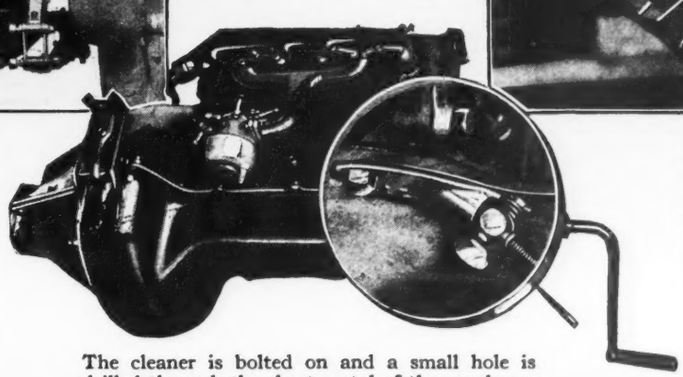


Spark plugs can be cleaned thoroughly, it is claimed, with this new compressed-air device that blows against the plug an abrasive mixed with a cleansing liquid

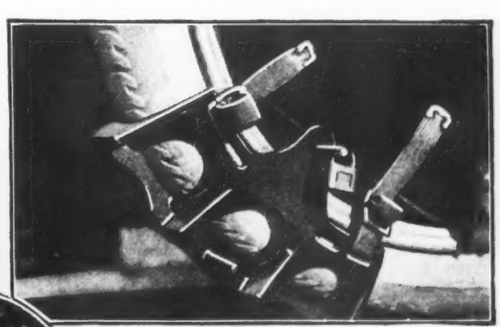


The advantage of this novel tire carrier is that it also serves as a useful support when a tire is to be changed. It is designed to split the rim so that the tire may be mounted or removed—a task that ordinarily is performed on the ground where harmful dirt may get into the tire and on the tube

Designed to clean out the clogged oil line quickly, the attachment shown below consists of a petcock cast on a special bracket, a gasket, and a flexible cable long enough to reach through the line in the crankcase of the engine



The cleaner is bolted on and a small hole is drilled through the sheet metal of the crankcase



Another useful type of tire carrier consists of two supporting units that may be removed from the rear of the car and used as mud hooks, as shown above. Each unit is equipped with a locking attachment to protect the car and the tire against theft. The device is especially useful to carry on trips over uncertain roads

Automobile Ideas that Save Money

"MORE miles a gallon!" is the cry of every motorist. An efficient gas saver can be made in the home workshop, as shown in Fig. 1. The intake manifold is drilled and tapped for a carbureter elbow. A section of pipe is led from this to the dash, where it is fastened to a tee draincock such as was used in old Ford carbureters. The joint should be packed and soldered to make it mechanically and thoroughly airtight.

By opening the needle valve, air can be admitted to the intake manifold, where it can mix with the explosive mixture from the carbureter. When the engine is warm, there is no need of the rich mixture required for starting, so the motorist can open this air valve at any time without leaving his seat.

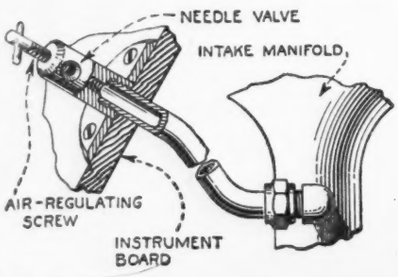


Fig. 1. Dash adjustment for air

AN OLD headlamp can be made to assist greatly in illuminating the interiors of motors undergoing repair at night. The lamp is mounted on a board (Fig. 2) and the lens is covered with a wire screen to prevent tools from breaking it. A screweye placed in one end of the board allows it to be hung up on the wall or fastened to any convenient part of the engine.

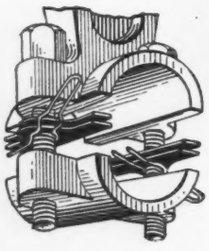


Fig. 4. Holding shims with hairpins

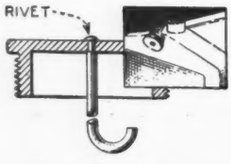


Fig. 7. Radiator cap

WITH a bar such as a rake handle and two ordinary shelf brackets, a wheel liner for testing the alinement of the front wheels can be quickly made. The long ends of the brackets are bent outward at right angles so that they can be hooked to the spokes. One bracket is screwed tightly to one end of the bar, but the other is left off. The bent arm of the stationary bracket is placed on the forward end of a wheel spoke, as shown in Fig. 3, and the other is moved out on the bar until it bears against the corresponding spoke on the other wheel. This distance is marked on the bar. The distance between the rear of the wheels is then measured in the same way. Any difference in the measurements indicates wheel misalinement, which should be corrected.

ONE of the annoyances encountered when overhauling a motor is the falling down of shims while placing the cap on the connecting rod. This can be remedied by using two crinkly hairpins to hold the shims on the bolt, as shown in Fig. 4.

THE positive terminal of a storage battery very often corrodes if it is not kept well greased, and in time the connection becomes loose. While the best method of repair is to make a new terminal, a temporary repair can be made by driving a wire nail between the post and terminal in the manner shown in Fig. 5.

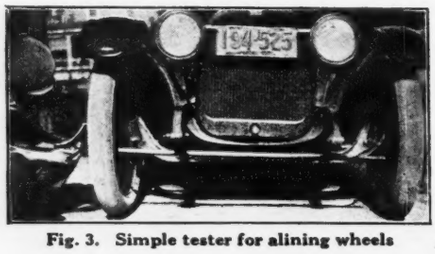


Fig. 3. Simple tester for alining wheels

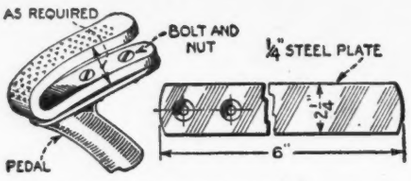


Fig. 6. Cheaply made pedal extension

Fig. 9. "Pumping" to start flow of gasoline

ON MOST cars there is no way in which the pedals can be adjusted to conform to the length of the driver's limbs. This adjustment can be made by bolting a bent piece of ¼-in. steel plate to the pedal as shown in Fig. 6. The height of the extension is determined by trial and the top is roughened or checkered to prevent the foot from slipping.

WHEN filling the radiator, it frequently occurs that the cap is misplaced, broken, or laid upon the running-board, forgotten, and lost. By fastening a hook of ¼-in. steel rod to the cap, as shown in Fig. 7, the cap can be unscrewed and hung over the opening during the process of filling the radiator.

VALVE noises can often be reduced by altering the shape of the valve stem where it bears on the tappet. By grinding this end into the form of a half sphere (Fig. 8), the area of contact is reduced and correct clearance can be more easily secured and maintained.

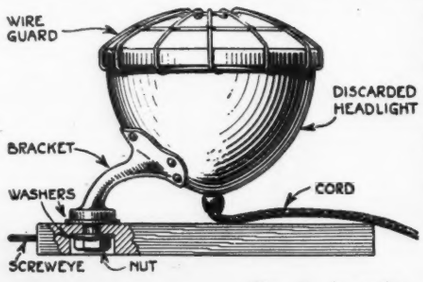


Fig. 2. Powerful light for repairs

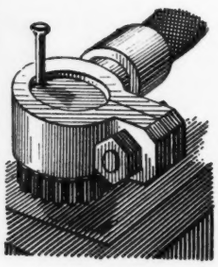


Fig. 5. Nail tightens battery connection

Fig. 8. Valve stem

TO SIPHON gasoline out of a barrel, use a rubber hose that will not bend too easily. Have one about the size ordinarily used on a small foot spray-pump. The hose should be 2½ ft. long.

Put one end down in the gasoline barrel and hold the other end in the hand with the ball of the thumb over the end (Fig. 9). Now, with a quick jerk, bring up the hose about 6 in., removing the thumb, and as quickly shove it down 6 in., again putting the thumb over the end. Repeat this operation until the gasoline starts, then quickly drop the upper end of the tube into the receptacle and it will siphon out the gasoline.

BROKEN springs in passenger-cars and trucks are a common occurrence even when precautions have been taken to tighten the retaining clips. The nuts to the spring clips may be pulled up fairly tight, yet the spring leaves may not be solidly together, as they should be to prevent breakage. The better method of tightening the spring clips is to do this when the car or truck is loaded. Test this out by tightening up the clips and then loading.

APART from replenishing the distilled water in the battery cells, the operation of the car is a conspicuous factor in maintaining the battery charge.

An engine with clean spark-plugs and a carbureter so adjusted that the second or third turn causes it to start is essential to a battery that is to be kept charged.

The Home Workshop

Arthur Wakeling, Editor

How to Build Ornamental Trellis-Work

ORNAMENTAL trellis-work affords a happy solution for the home worker who wishes to use the lengthening daylight of spring evenings to improve the appearance of his house and garden. He very easily can take a leaf out of the notebook of architects, who often use well-designed and carefully placed trellises to give an added touch of beauty to already finely proportioned residences.

In these days of high building costs the majority of houses are necessarily made as plain and boxlike as possible, and there is not a great deal the owners can do to improve their appearance except to keep them well painted, and to add such features as the flower boxes described in last month's Home Workshop Department and trellises such as those illustrated on this page.

Beautiful and durable trellises for house and garden

Several types of construction are shown and these designs, which were developed by George F. Kaercher especially for the Home Workshop series of blueprints, may be modified or combined in endless ways.

THE design below is used flat against the wall of a building and often will redeem miraculously an otherwise unattractive and perhaps poorly balanced facade.

More elaborate than this and especially effective with houses of the long, narrow type, is the trellis screen and garden gate illustrated in Fig. 2. This is designed to extend from the wall of a house, dividing the flower garden from the laundry or service yard. It could be used also to separate a formal from an old-fashioned garden or a flower garden from the children's play-yard, or for similar purposes.

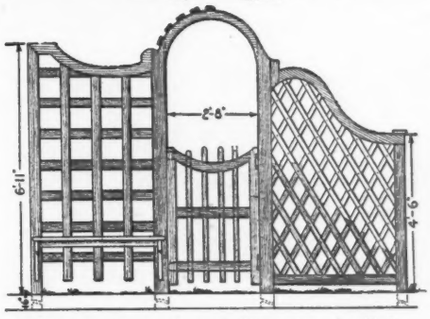


Fig. 2. Design for a trellis screen, detailed in full on Home Workshop Blueprint No. 34

The view in the lower part of Fig. 2 really shows two designs combined to save space; both sides ordinarily are made alike, as in the upper drawing, but the combination also is effective and has advantages in certain locations where the informal, steplike profile of the top harmonizes with other features of architecture or landscape.

Figure 3 shows a simplified construction of the familiar fan trellis now enjoying renewed popularity. It can be used as a full spread fan, as a half fan at a corner, or as a double corner ornament, half the spread being on one wall and half on the adjacent wall.

The fourth suggestion (Fig. 2, above, and Fig. 6, page 122) is a simple trellis-work sun-dial, which, while a garden ornament pure and simple, is especially suited for use in conjunction with other trellises, arbors, or pergolas.

Elaborate as these trellises appear when finished, their construction is surprisingly easy and well within the ability of any man handy with woodworking tools. And the construction is sturdy enough to insure the trellises' lasting for years, and not falling apart as sometimes is the case with flimsy and hastily built woodwork of this kind. For durability, cypress, white pine, or other weather-resisting wood should be used.

The trellis in Fig. 1 is supported by two boxlike posts, which project 18 in. into the ground and extend 7 ft. 9 in. above. They are 6 ft. 2 in. apart from outside to outside. Each post consists of a back and front face stile ⅞ by 4 in. by 9 ft. 3 in., an end filling piece, ⅞ by 2¼ in. by 9 ft. 3 in., and an inside filling piece ⅞ by 1⅜ by 9 ft. 3 in. Before the front face is nailed on, the inside filling piece, as shown at the right of Fig. 1, is nailed to the back stile and then the cross members or rails are nailed to the filling piece. The gaps between the rails are filled with short filling pieces, ⅞ by ⅞ by 10 in., and the face stile then can be nailed on. In this way, it will be seen that all the usual difficulties of notching or fitting are avoided.

THE center muntin or upright division is ⅞ by 4 in. by 8 ft. and the two shorter side muntins or divisions are ⅞ by 3 in. by 6 ft. The 5 rails are ⅞ by 3 in. by 9 ft. 9 in., the straight cap across the top is 1¾ by 4 in. by 5 ft. 6 in., the post caps are 1⅛ by 5 by 7 in., and the post ornaments are 1¾ by 4 by 5 in.

The central circle is 2-ply, being built up of semicircles cut from 4 pieces ⅛ by

(*Continued on page 121*)

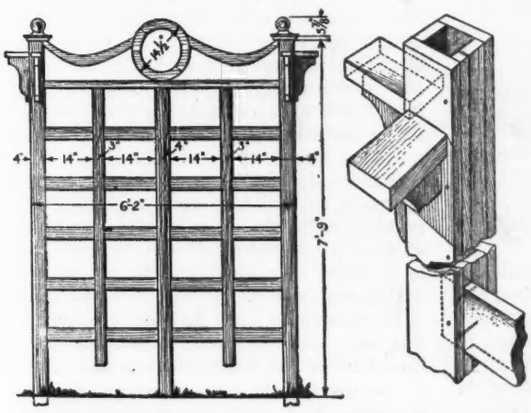


Fig. 1. An architectural trellis used against a house wall, and detail, explaining construction, of the posts

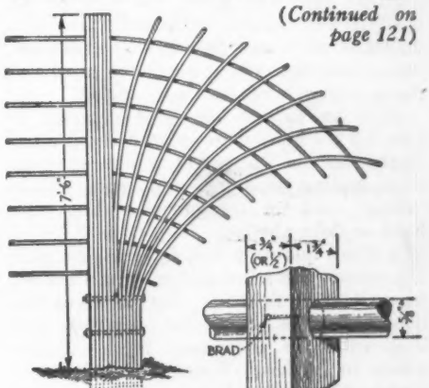


Fig. 3. A simple fan trellis, showing how the bars are first bolted together and spread

Speedy Toy Motorboat Built from Old Crate

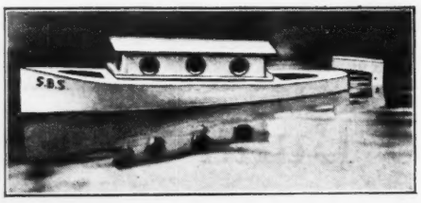
TO BUILD a model motorboat from 1 to 2 ft. long with a spring-motor drive is not difficult. Little more is needed than a knife, a saw, a hammer, a few small, thin nails, an empty egg crate, and a spring motor salvaged from an old toy.

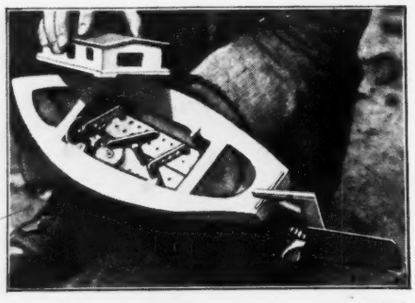
Take off the thin sides of the crate and soak them thoroughly in water for at least 12 hours. In the meantime construct the keel, ribs, stern and prow from the thicker end pieces of the box.

The keel is about 1 in. high and as long as the model is to be. The stern is a narrow tapering piece of wood about 2 in. wide at the top and slanting inward to the thickness of the keel at the bottom. The prow is either a straight piece of wood the thickness of the keel, or it is slightly curved. Both prow and stern are nailed firmly to the keel.

The two ribs are, in reality, two pieces of the thicker wood cut 2 or 3 in. wider at the top than the stern. These also are attached to the keel and divide the boat into three parts, as shown in the illustration.

One of the thin watersoaked boards can now be nailed in place. One end is fastened to the stern and a long edge is nailed along the keel. Then the board is bent and nailed along the ribs and to the prow. The same is done on the other side and any overlapping parts are carefully cut away with a sharp knife. Sometimes, when the board is bent, it does not reach the top of the ribs amidships. This can be fixed by cutting strips to fit between the board and ribs. Do not force the thin wood or bend it too violently toward the top of the ribs. When dry, the boat is painted with white lead or other paint.





The toy boat afloat (above), and lifted from the water for winding (at left)

The motor can be the spring drive of an old toy locomotive, if the spring and the gears are in good condition. Take out the spring as a whole and mount in the boat on a block. Attach a small gear wheel to the drive shaft and a corresponding pinion or smaller gear to the shaft carrying the propeller. The gear and pinion can be obtained in any large department or toy store, as they are sold as additional parts for toy construction sets.

The propeller, made from a piece of sheet tin or zinc, is attached to the shaft with solder or by two collars and setscrews.

A rudder completes the boat except for the cabin, mast, and other refinements, which may be added to suit the taste of the builder.—E. B.

Simple Repair Tricks that Triple the Life of a Canoe

WITH proper care a canvas-covered canoe should last 25 years. This may appear questionable to any one who has discarded one of these light craft after a few years of service because it leaked. The writer, however, knows whereof he writes, as he still has in service a "leaky" canoe that was thrown away 12 years ago by its former owner.

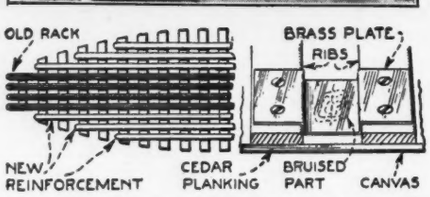
When it came into the writer's possession, the light 3/16-in. cedar planking was dry and cracked in so many places that the bottom would give when stepped on while the canoe was in the water. An inspection showed that water was coming in through half a dozen holes, which apparently had been made by stones or snags.

AS THE outer coating of paint was badly cracked, the first step was to remove all paint and enamel with a paste of soap powder and hot water. This mixture was smeared on ⅛ in. thick and allowed to remain overnight. With the aid of an old hunting-knife the paint was scraped off easily. The filler in the canvas next was attacked with a scrubbing brush and hot water and the canvas scrubbed until the outer surface was clean and white.

After the canvas had dried for a day or two, all the holes were located and sealed. Right here is the secret of the process. The sealing is done—not with canoe "dope" sold for the purpose—but with hard or flake shellac.

A small quantity first is sprinkled over the canvas and a hot soldering iron is used to melt and rub it in. Do not have the iron nearly as hot as for soldering, and stop work for a moment if the shellac starts to bubble. When a hole is completely filled, allow it to cool and pare off most of the surplus with a sharp knife.

Next, sand down the spot level with the surface of the canvas, using No. 2 sandpaper wrapped around a small block of wood. The hole now is sealed with a substance harder than the surrounding canvas and yet sufficiently elastic to prevent cracking; in fact, the patch is stronger than the canvas itself.



Method of sealing holes with hot shellac and repairing planking and floor rack

Proceed in a similar manner with all the remaining holes. If one of them happens to be an extra long slit or a three-cornered tear, tuck a small piece of cotton drill under the canvas at this point and run in as much of the melted shellac as possible without producing too much of a bulge.

The next operation is to refill the canvas with a coat of yellow ochre. About 1½ lb. dry powder is required for a 17-foot canoe. It should be mixed with boiled linseed oil and a small quantity of turpentine. The consistency of the mixture should be somewhat thicker than that of ordinary paint.

This coat should dry in about a week, while the inside of the canoe is being renovated. Over every spongy or badly cracked spot should be placed a brass plate 1/32 in. thick, as shown in the diagram. If the bottom seems weak, the regular rack should be enlarged, as indicated in the diagram. The wide pieces are nailed with brass nails so they come between each rib of the canoe. The long slats also are increased in number so that the whole bottom is protected. It is necessary to remove the thwarts when placing this rack in position.

WHEN the ochre filling is hard, sand it with No. 2 sandpaper and lay on a coat of coach paint or, if preferred, one of the so-called canoe enamels, which are very satisfactory but expensive. Coach paint is a perfectly flat color that should be mixed only with turpentine so that it dries very quickly. The best surface finish over the color is spar varnish, three coats being put on about 40 hours apart.

The inside of the canoe usually cannot be made to look like new, but it can be greatly improved by a careful scrubbing with soap and water followed by two coats of light oak varnish stain after the surface is thoroughly dry.

If reasonable care has been exercised and the painting and varnishing done under cover and where there is little dust, the result will be a canoe nearly as good as new. If a new hole appears at any time, repair it by the shellac and hot iron method.—E. E. SCOTT.

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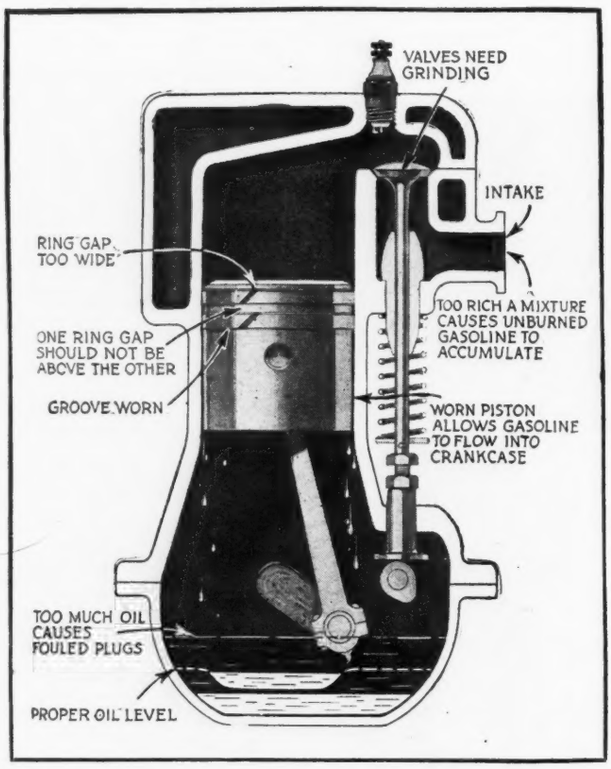
Making Your Spark Plugs Last 28,000 Miles

By Ray F. Kuns

IS YOUR auto tuned up to top-notch efficiency? If it isn't and you have any of those annoying little misadventures that fall to the lot of so many motorists, you will find a vast amount of helpful information in this and following articles of a noteworthy series by Ray F. Kuns, principal of the Public Automotive Trade School, of Cincinnati, Ohio.

"MAYBE I wasn't mad!" said a motorist to me the other day. "I had that set of plugs in use for 28,000 miles, and when I allowed my boy to clean out the carbon, he broke one of the original plugs, and I have had to put in a new one. I was proud of that set of plugs. Do you know, I never cleaned those plugs but once, and that was after I got out of the hospital. Every one had been driving the car, and it seemed to be in terrible condition. I took out the plugs, and they were choked with oil and carbon. The folks must have kept the carburetor choked all the time, and pumped the cylinders full of oil and gas."

This owner went on to tell me that he had cleaned the plugs roughly, had the old oil drained and the proper amount of oil placed in the crankcase, shut down the gas mixture to the proper point, and shortly all the plugs were burned clean again without further attention.


VALVES NEED GRINDING
INTAKE
RING GAP TOO WIDE
TOO RICH A MIXTURE CAUSES UNBURNED GASOLINE TO ACCUMULATE
ONE RING GAP SHOULD NOT BE ABOVE THE OTHER
GROOVE WORN
WORN PISTON ALLOWS GASOLINE TO FLOW INTO CRANKCASE
TOO MUCH OIL CAUSES FOULED PLUGS
PROPER OIL LEVEL

This chart shows at a glance the most frequent causes for carbon-coated, oil-covered spark plugs; the plugs themselves are rarely to blame

A physician can gage the condition of a patient by the condition or coating of the tongue. The car owner and mechanic can gage the condition of the engine by the coatings on the spark plugs. A coating of oil may mean bad rings, sloppy pistons, scored cylinders, poor oil, too much oil, and similar shortcomings. Sooty, fouled plugs may mean too rich a mixture. Clean brown or tan porcelains mean a good mixture burned in an engine that is performing well.

Since the plug appearance is an index of condition of the engine, it is well to heed its warning, and instead of trying to make the engine right by cleaning the plug, make the engine itself right.

Plugs do not fail along with other engine parts. The life of a good plug is measured in tens of thousands of miles. Where a plug seems to be bad, move it from cylinder to cylinder of the engine. Only if the trouble moves with the plug, should it be discarded. If the trouble remains in one cylinder and successive plugs fail to fire properly, the parts belonging to that cylinder must be made right.

After plugs have given service for a long term and one is broken, it is well to replace all. Take care of the new set by keeping spark, mixture, oil, and compression right. Then there will be no need to be changing them daily and tinkering with them continually, and you, too, will regret when after two or three years' service, one is inadvertently broken.

Ornamental Giraffe Upholds Ashtray

THIS unique smoking stand affords an opportunity for the man who likes to make things with tools to exercise his skill and ingenuity.

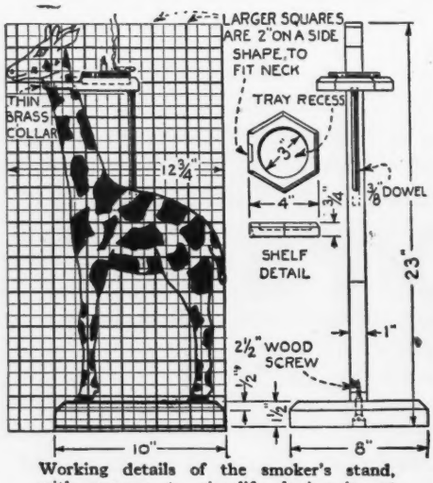
It is best to make the parts of hard wood; the work is more difficult, but a lasting job is assured. The figure should be cut from a board so that the grain runs vertically. A turning saw may be used, if at hand, but a compass saw will do the work quite quickly.

The base, which is 1½ by 8 by 10 in., has a ½-in. chamfer around the top edges. The figure is fastened to the base with 2 2½-in. bright flat head screws, set into the base ½ in.

The tray shelf is cut from ¾-in. stock, 5 in. square. Lay out a 4-in. circle and scribe a hexagon outside of the circle. Saw this out, plane the edges smooth, and plane a ¼-in. chamfer on five of the top edges.

A circular hole is next cut in the top side of the shelf to suit the ashtray to be used. The hole should be as large as the ashtray in diameter and should be deep enough to prevent the tray from sliding off. On the sixth side, which has not been chamfered, cut a recess to fit the neck of the giraffe. Also bore a ⅜-in. hole ⅛ in. deep on the bottom of the shelf, as shown.

Fit the shelf to the giraffe and locate the spot where the dowel support will rest on its back; then bore a ⅜-in. hole ¾ in. deep. Glue the dowel support to the figure and to the shelf. Two No. 16 2-in. brads should be driven through the neck of the giraffe into the shelf below the bottom of the opening for the tray. Then, to strengthen the job further, fasten a thin piece of copper or brass around the neck of the figure and nail both ends.



Working details of the smoker's stand, with squares to simplify laying it out

To make the stand realistic, the giraffe is painted a neutral yellow. Black is used for the outline and the spots, and the base and shelf are also enameled black.—KENNETH R. LA VOY, New Rochelle, N.Y.

How to Re-Thread Worn Nuts and Screws

THE threads of a screw or nut, or both, belonging to some essential equipment sometimes become stripped and the whole machine is made useless. The particular screw or nut may be an odd size, perhaps with an irregular lead, and no tap or die at hand will suit it.

In case a nut has failed, as is more often the case, make a tap out of the steel screw by fluting the first few threads with a file; then harden this portion by heating it and quenching in water or brine. If the screw is merely machinery steel or refined iron, heat the screw and immerse it in cyanide of potassium, treating it with two or three heatings. Then heat it to a bright red and quench it in brine.

The nut is then squeezed together on all sides in a vise and forced over the improvised tap. By this means I have repaired surgical instruments with metric threads, bicycle parts, lawnmower parts, and a variety of home implements.

When the nut is in good condition, it may be fluted and hardened to serve as a die. Usually there is sufficient stock unthreaded on the bolt to allow new threads to be cut. It is best afterward to soften the part that has been hardened so that it will not break when replaced in the machine or implement to which it belongs.—O. S. MARSHALL, Springfield, Vt.

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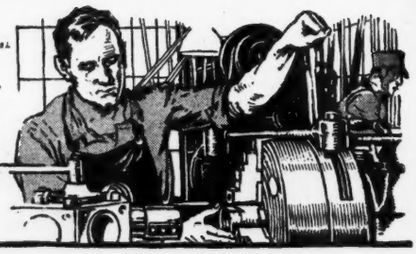


Die-Making Simplified for Every Machinist

By S. A. McDonald

Die-Designer and Expert on Punch Press Practice

JOHN SMITH, able machinist, may have some misgivings when confronted with a punch-and-die job, as to his ability to do the fine work he sees the experienced die-maker perform. He may not realize that a first-class machinist does just as fine work, using the same machines, tools, and measuring instruments, as the die-maker. It is only that he lacks experience in this line of work.

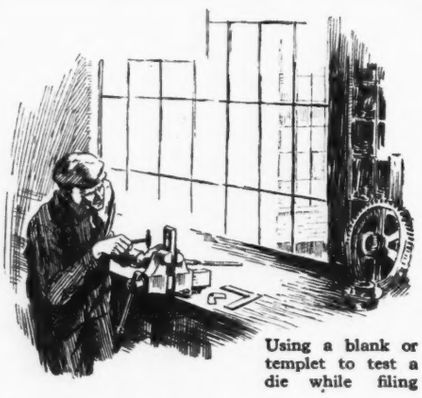
There are a number of outstanding features in the making of punches and dies that every machinist should know. These, added to the experience he has in his own line, should make it possible for him to handle the average punch-and-die job.

To bring out some of these points clearly, let us take the blanking die for the simple blank shown in Fig. 1 and carry it through to completion.

In some shops it is the custom to design the dies in the drafting department, and the machinist or die-maker is given a fully dimensioned drawing. This simplifies the work, and where there is a lot of die work, it is a good policy. In the smaller shops the custom is to work to a sample or sketch of the piece, and the die-maker has to design and make the punch and die.

If only a sketch of the blank has been furnished, the first thing to do is to make a blank by scribing and cutting it out from a piece of metal of the same thickness as the punching wanted. A rough sketch of the punch and die then should be made. This need not be fully dimensioned, but clear enough in detail so that the design is understood and the material can be ordered from it.

The punch and die (Fig. 2) are well suited for this blank. The cast-iron die shoe shown is adaptable for a variety of work, and therefore usually is carried in stock. It is shaped off on the bottom, turned over, and the dovetail is shaped out to receive the die. A gage (Fig. 3) should be made for gaging the dovetail accurately and for testing the corresponding dovetail on the die. The dovetail in the shoe is cut on one side to a taper of ½ in. to the foot, to suit the taper of the wedge that holds the die in place.



Using a blank or templet to test a die while filing

The die should be made of good quality tool steel. It is shaped to fit the shoe with the wedge in about a central position. The top face is finished off smoothly and a coating of copper is given to it by applying a solution of blue vitriol. This makes a good surface for scribing the blank's outline.

BY CAREFULLY laying out a series of prick punch marks for the die opening, it can be drilled so that only a thin wall will be left between the holes, as shown in Fig. 4. These holes are reamed with a taper reamer from the bottom so that the die will have the proper clearance.

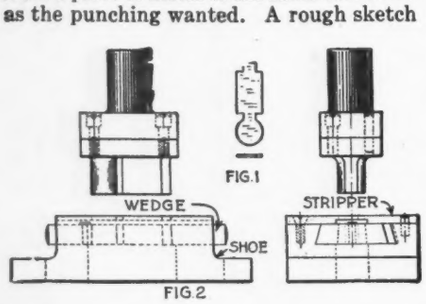
A chisel (Fig. 5) is used to cut down the walls between the holes in order to remove the core. The die opening is then filed so that there remains only a series of slight grooves left by the reamers.

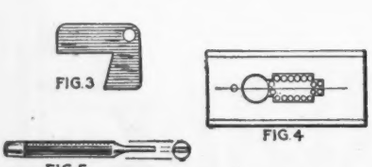
A stem now should be soldered or riveted to the blank so that it can be held while it is being fitted into the die. The die should be held vertically in a vise, with a strong light in front of it, so that when the blank is being fitted into the die from the bottom, the high points that the blank catches on can be seen clearly and marked. The die then is filed at these high points, and the blank again is fitted. This is repeated until the blank touches all around and is flush with the top face of the die.

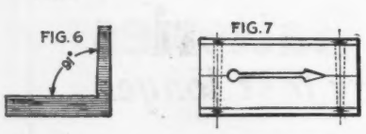
A clearance gage (Fig. 6) at an angle of 91 degrees now should be made. It is used when filing the clearance that permits the blanks to fall freely through the die. Care must be taken in filing out die openings to see that the cutting edge is not rounded or tapered in the wrong direction. This can be avoided by testing frequently with the gage. In this particular die, one end is a circle, so there is no need of filing if a suitable taper reamer is at hand.

After drilling the hole to take the locating gage, the die is ready for hardening. The hardening usually is done in a gas furnace. The die is brought slowly to a cherry red. It is advisable to heat the jaws of the tongs with which the die is handled; otherwise they are apt to chill the die where they grip it when removing it from the furnace. If there is no pyrometer to gage the temperature of the die, and there is doubt as to just how red the die should be, it is advisable to put a few scraps of the die steel in the furnace to heat with the die. These can be used as test pieces, so that by dipping them in water and testing them with an old file for hardness, the right heat can be ascertained.

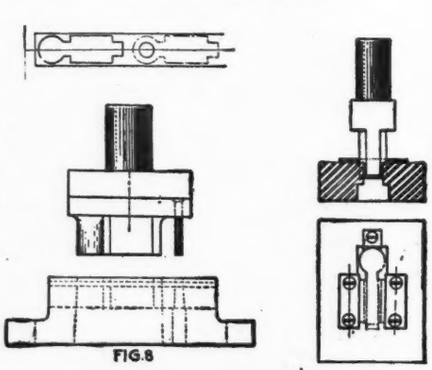
(*Continued on page 94*)

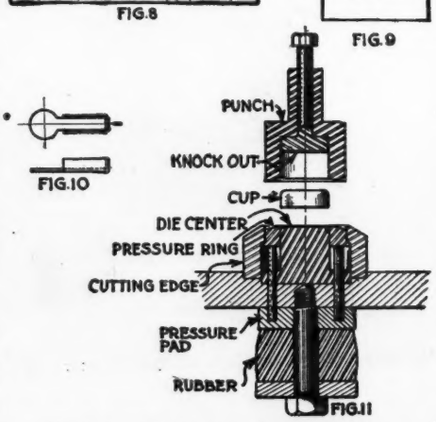






Simple punch and die method of drilling die, two-piece die, and gages and chisel





Typical gang die, forming die, and combination die used for making cup shapes

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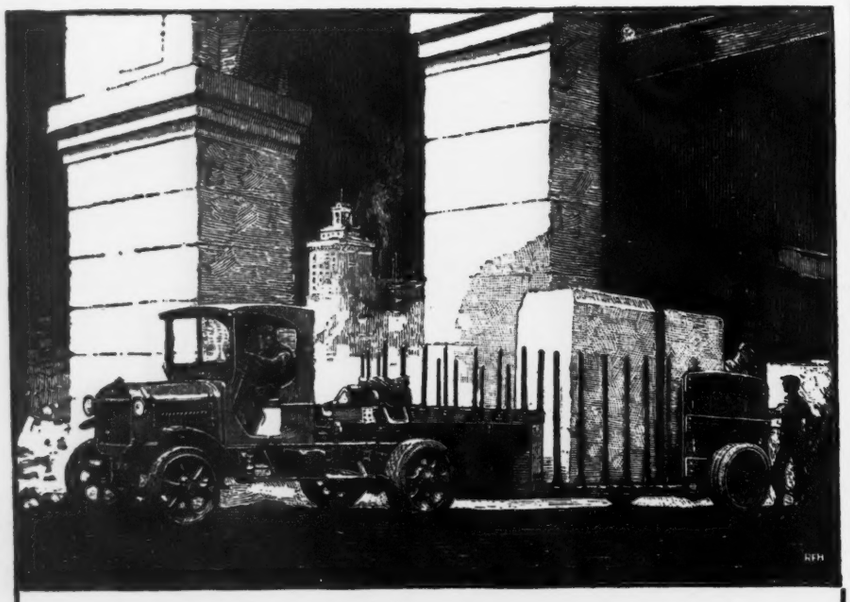

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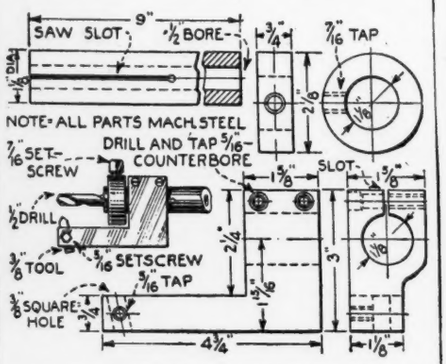
Holder for Drilling and Turning in One Operation

A HANDY drill- and tool-holder for use on screw machines and automatics is detailed below. Simplicity of construction, operating efficiency, and low cost are among its features.

The body of the holder is made from a solid piece of machine steel. It is provided with a clamping arrangement for



Details of simple dual purpose tool-holder for use on screw machines and automatics

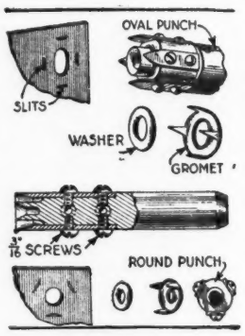
holding the drill and a slot in the projecting lug for a toolbit, which is set for the required diameter.

The turning tool may be adjusted readily for any diameter within the range of the tool. Drills of various sizes may be used either by turning the shank on large drills to fit the split bushing or by using separate split bushings for the smaller sizes.—JOHN LARSON, New Britain, Conn.

Making a Gromet Punch

WHEN repairing old side curtains, or refitting new curtains, a gromet punch is a handy tool. Many mechanics attempt to cut the slots for the prongs and the hole for the opening with a pocket knife, but slash through the leather, and the result is a bad job.

A gromet punch is made from a piece of chisel steel, the lower end being shaped either oval or round to suit the type of gromet used. The oval style has four prongs, while the round has three.



Punches for round and oval gromets

The opening punch is tapered out internally to a sharp cutting edge, and the sides are then filed off flat for the reception of the prong hole knives, the rear ends of which set against the square corners of the filed-off flats. These knife blades are made of annealed hacksaw blades, the thick power saw variety being the best to use. They are ground with an inside radial bevel, as shown, and should be whetted very sharp.

IN ALL cases where zinc chlorid is used as a flux, the article should be cleaned thoroughly after soldering.

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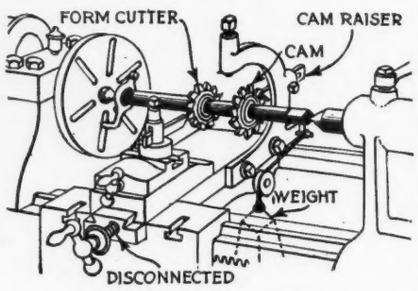
"The Standard of the Mechanical World"

Relieving Milling Cutters on an Ordinary Lathe

By John Aures

THE relieving attachment illustrated below for backing off form cutters in a lathe, should prove very useful in a small shop where there is no special machine for this class of work. This simple arrangement will do the work about as well as an expensive relieving machine.

A gear-cutter having the same number of teeth as the cutter to be backed off is held on a milling machine arbor or keyed on a special arbor about 2 in. from the other cutter and the arbor is placed between the lathe centers. The gear-cutter,



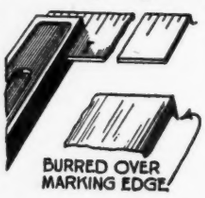
A gear cutter is used as a cam to transmit motion to the lathe tool

which is to be used as a cam, is placed on the arbor just the reverse of the cutter to be backed off. The follower rest is bolted to the carriage and a piece of hardened steel, ground on one end somewhat like a tooth on the cam cutter, is fastened to it in place of the usual piece of bronze.

Disconnect the cross-slide screw where it is screwed to the apron and fasten a weight over a pulley on the cross carriage. The cross-slide screw is set so that the weight will pull the lathe tool clear of the tooth for the next one as the cam rises. For feeding the tool to the work, the compound rest screw, of course, will have to be used. The lathe should be run on its slowest speed as the tool's working in and out naturally will cause a chatter.

Marking Wood with Try-Square

BY BURRING over the edge of a try-square and sharpening it as indicated, a carpenter can mark small lumber for sawing by merely pressing the square in place. The edge leaves a sharp mark that is more accurate than one made with a pencil and the time needed in handling a pencil is saved. The device is especially useful when a large number of small pieces have to be marked.—H. E. B.



Brazing Bandsaws

AFTER many wearisome experiments with fluxes for brazing bandsaws, I find that a mixture of 3 parts boric acid and 1 part of borax dissolved in just enough hot water to make a solution, is a satisfactory combination.—W. A. LYON.

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When Mother issues specifications for a job

FUNNY thing about women-folk. When they put us on one of those round-the-house carpenter jobs, they not only tell us we've *got* to do it but they look at us in a way that says *we can't!*

Let's get together on this thing, men! We can't do a regular job when we use a can-opener for a screw-driver and a bread-knife for a saw. We've got to have *tools*—good tools.

Let's show 'em. Begin to assemble your complete tool outfit with a Simonds Hand Saw, a Simonds Hack Saw and a Simonds File. Then you'll have *tools*—tools that were famed for their cutting qualities before most of us cut our baby teeth.

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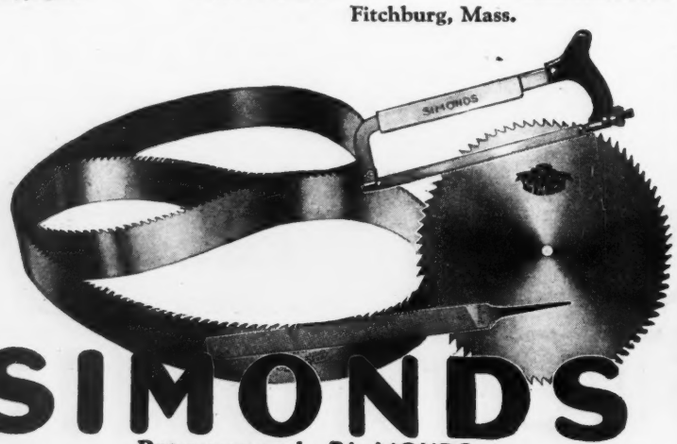

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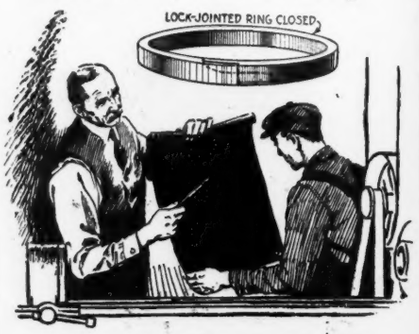
How Would You Solve This Problem in Foremanship?



Two prizes offered for the clearest explanation of how to machine this piston ring

IMAGINE for the moment that you are a machine-shop foreman. You have just received a blueprint on which is detailed the special interlocking piston ring illustrated above. It is for use in connection with a small air pump, and a glance shows you that the designer found it necessary to lock the rings securely because of the design and location of a port.

If you have handled similar problems before, perhaps you will not have to think twice as to the best method for machining the rings, but the question is—how will you explain to a relatively green machine hand the simplest and quickest way. It's a problem in foremanship.

For the clearest letter giving this information, POPULAR SCIENCE MONTHLY will award a first prize of $10. For the next best letter, a prize of $5 will be given. The contest will close on May 20 and the winning letters will be published in the August issue. No letters returned. Address Shop Contest Editor, POPULAR SCIENCE MONTHLY, 225 West 39th St., New York.

Cutting-Off Lathe Tool

MOST machinists experience trouble at some time or other with their cutting-off tools. When you are up against a tough job, try a tool made as illustrated. This is a conventional tool altered by cutting a semicircular groove in the center of the blade.

Makes shearing cut

The tool makes a shearing cut and, used on cast iron, never digs in. I have made cuts 4 in. or more deep with a tool ½ in. wide without breaking it.—S. L. ROBERTS.

Ball-Turning Tool

FOR turning ball ends on steel rods and similar work, some kind of a special forming tool is necessary. The hand tool illustrated is designed for finishing such work after it has been carefully roughed out to a templet by manipulating the lathe carriage and cross feed.

For finishing work

A tool of this type is especially adaptable for brass work.—H. W.

KRAEUTER & CO.

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YOU may need them out on the road, in your garage or around the house—for anything from fixing your car to making radio connections—but when you *do* need pliers, you want the best.

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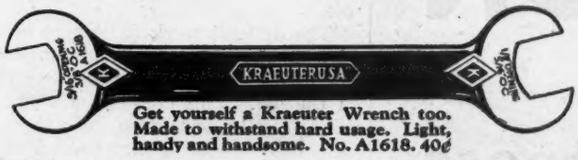

Get yourself a Kraeuter Wrench too. Made to withstand hard usage. Light, handy and handsome. No. A1618. 40¢

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NICHOLSON FILES
~a File for Every Purpose

Die-Making Simplified

(*Continued from page 86*)

The die should be removed quickly from the furnace and dipped vertically into a large tank of lukewarm water and gently swayed back and forth until it is cool enough to touch with the hand; then it should be left to cool in a bath of oil.

The die is now hard—too hard to stand the shocks to which it will be subjected in service—so it is necessary to draw the temper somewhat. To do this a plate is heated to a red. The top face of the die is polished to remove the scale and the die is put on the hot plate, face up. As the heat penetrates the die, the polished surface will assume a straw color. If one section seems to color too rapidly, that part can be retarded by bathing it with oily waste. After the die has reached an even straw color, it is cooled in oil.

THE bottom of the die now should be ground flat in a surface grinder. The top also should be ground, but it is ground tapering from the center toward each end to give the punch and die a shearing action. This reduces the shock to the press. One of the best and simplest methods of fastening the punch to the punch holder is by fillister-head screws and dowel pins, as shown in Fig. 2.

The punch is laid out by scribing the outline of the blank on the face of it and then is machined to the scribed line, just enough metal being left for fitting. The cutting edge of the punch is given a slight chamfer so that when the punch is set up in the press and the die brought in place under it, the punch can be started into the die. While the punch is in this position, the die is bolted down.

If the punch has been carefully made and set, by bringing it down with a light bump on the die, a distinct impression of the die will be made on the soft punch. The punch then should be raised and the excess metal filed off so that when the punch is brought down again, there will be only a light shaving taken down the sides of the punch.

ON PUNCHING thin stock it is necessary that the punch and die fit snugly; but on heavy stock it is customary to leave about one-tenth the thickness of the stock as clearance between the punch and the die.

Practice varies as to whether the punch should be hardened or left soft. There are many points in favor of both methods, but in the majority of cases it is left soft. This is done because the punch is a simpler part to make than the die if, through improper setting, one of the two becomes sheared and spoiled. Also, when the punch becomes dull, it can be sharpened by upsetting the cutting edge with a hammer while the punch is still in the press, and shearing the upset edge through the die.

The difficult work (if it may be called that) is now finished. There remains only the fitting of the stripper plate to the top of the die. This consists of a flat plate with a slot twice as deep and a little wider than the stock being punched. The opening for the punch to pass through is made a loose fit except when the punch is long

(*Continued on page 96*)

Tycos Temperature Control

THE SIXTH SENSE OF INDUSTRY

THIS is the age of steel. And steel is iron-*plus* heat. Not the heat of the sun that warmed the savage cowering on the rocky ledge before his cave, but the heat that has been made man's servant to use for his own carefully thought out purposes.

This subjugation of heat that has made possible manufacturing on a vast scale, has added another sense to man's five natural senses. It is *Tycos*—the sixth sense of industry.

The life blood of industry is heat—and *Tycos* indicates, records and controls this life blood. *Tycos* is always dependable, always accurate. Whenever heat is used, there is an instrument in the eight thousand types and styles made by *Tycos* that will indicate, record or control it.

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Tycos Engineers have effected very definite economies for manufacturers in every line of industry by applying *Tycos* —the sixth sense of industry.

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Strong master blade; punch blade for drilling holes and scraping insulation from wires; screwdriver; can opener and bottle opener. Stag handle.

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THERE was real need of a Man's Knife—the kind of knife a fellow wouldn't have to apologize for.

Now see what you get in a Remington Pocket Knife—knives made of Remington Steel to the *rifle maker's standards* of accuracy.

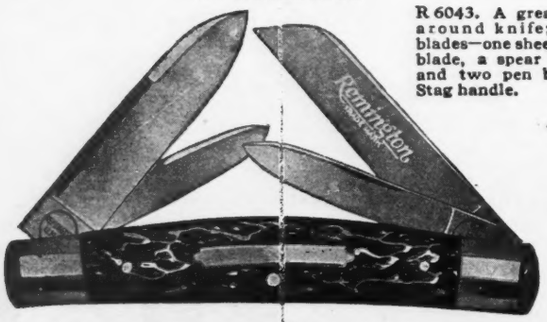
Look at the knives illustrated, sharp, strong, craftsman's blades—handy about the work bench, the car or working on the radio. Solid construction.

And they are just two of the many Remington Specific Knives for Specific Purposes. See them at your dealer's—knives for fishermen, carpenters, sportsmen, mechanics, farmers—in fact, knives made to men's individual needs.

To make sure of getting a Remington see that the name Remington is stamped on the heel of the blade.

Write for circular on Remington Carpenter's and Mechanic's Knives

Remington Arms Company, Inc., *New York City*
Established 1816



R 6043. A great all-around knife; four blades—one sheepsfoot blade, a spear blade and two pen blades. Stag handle.

Remington

THE AUTHORITY IN FIRE ARMS, AMMUNITION AND CUTLERY

Also makers of Remington Cash Registers

Die-Making Simplified

(*Continued from page 94*)

and thin; then it is necessary to make the punch a sliding fit.

The hole in the shoe for the blanks to pass through should be cut larger than the opening in the die so that if the die is set a little off center, the blank will not catch.

The gage pin for locating the stock is made in the shape of a flat-head rivet, one side being filed off so that a flat surface is presented to the stock being punched. There should be sufficient space between the top of the stop and the under side of the stripper so that the stock can be passed freely between them.

THE punch and die now being ready to operate, a strip of stock is put into the die so that it comes up against the gage. Then the press is tripped and a blank is punched. As the punch goes up, it carries the stock until the stripper strips it from the punch. At this point the stock is pushed forward so that it passes over the gage and the stock stops against the side of the opening that the previous blank came out of. A little experience makes it possible to run the press at more than 100 revolutions a minute.

There are many factors that affect the design of a die, one being the number of punchings wanted. If there are to be many, it pays to make an elaborate die; but if only a few thousand are wanted, a pretty crude die will prove satisfactory, as the blanks from both dies may be identical.

Sometimes a blank is so narrow that it is impossible to machine the opening in the die if it is made in one piece, so a split die is made as shown in Fig. 7. The two halves usually are held together with taper pins.

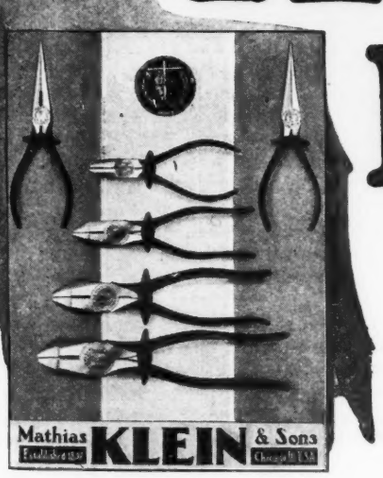
A forming die, such as is shown in Fig. 9, should be made when it is necessary to bend up the three sides of our blank in Fig. 10. This die consists of a plate with an opening over which a blank is put in a nest made of the three locating plates shown. The forming punch has one end machined to fit the inside of the formed blank, while the opening in the die corresponds to the outside of the turned-up sides. When the punch comes down on the blank, it forms it as it carries it down through the die.

THE gang die combines two or more operations at one stroke of the press on two or more blanks. Where it is necessary to punch a hole in the circular end of the punching first described, a gang die, such as is shown in Fig. 8, would be more economical than two separate dies. As will be seen, two operations are performed on the stock at one stroke of the press. The first blank punched is without a hole, but at each following stroke of the press a complete blank drops through the die. As many as 10 operations may be performed consecutively in this type of die.

The combination die differs from the gang die in that it performs two or more operations on one piece at one stroke of the press. In these dies are usually combined blanking, drawing and sometimes forming. This type of die is extensively used in making cup-shaped work. The

(*Continued on page 98*)

KLEIN PLIERS



Your hardware dealer will be glad to show you this display of six of the most popular patterns of Klein Pliers. You will find it in stores where quality tools are sold.

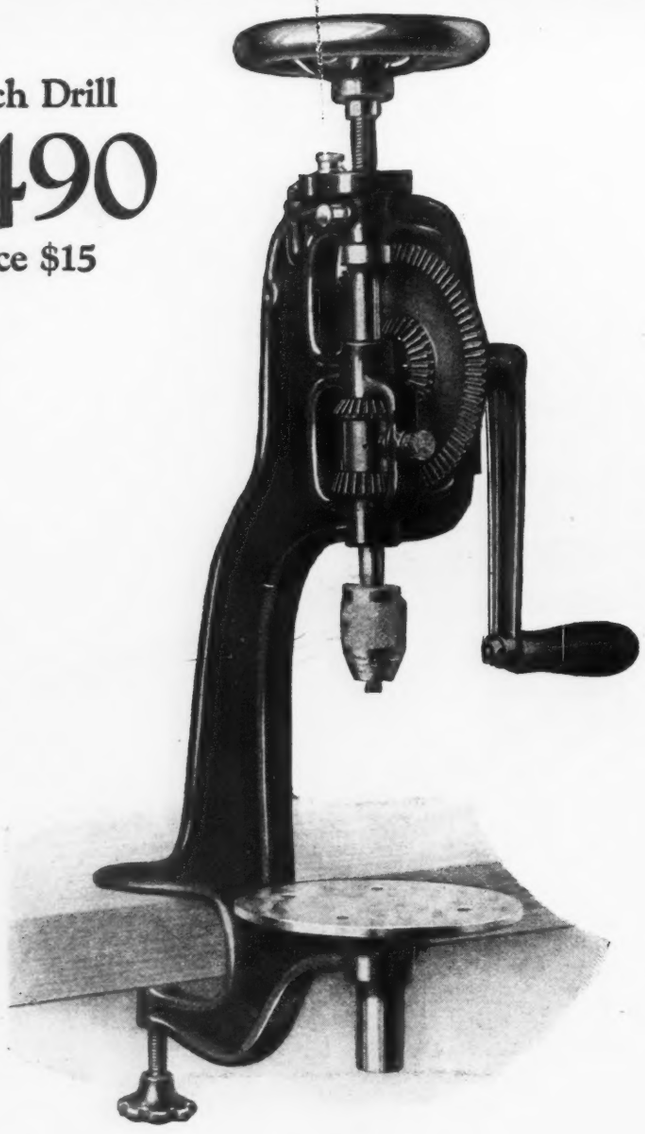
You bet it's a fine plier—it bears the Klein trademark!

Sixty-seven years of fine plier making are behind the comfortable way the handles are shaped, the easy spring of the handles, and the careful tempering of the keen knives.

Hammer forged from special bar steel, each process of manufacture subject to rigid inspection, Klein Pliers appeal to the man who is a confirmed buyer of quality tools.

Mathias KLEIN & Sons
Established 1857 Chicago Ill USA

Bench Drill
No. 490
Price $15



A drill with adjustable automatic feed

The automatic feed can be set to regulate the proper pressure for the size drill-point you are using, thus minimizing the chances of drill-point breakage.

Has two speeds. You merely turn the shifter knob on the frame.

All-steel chuck with three jaws that hold drill-points of all sizes up to 3/8 in. diameter. Eight steel drill-points from 1/16 to 11/64 inch are included with this drill.

Every craftsman needs some of the 1500 Good Tools made by Goodell-Pratt. Write for our free Catalog No. 15, which describes the whole line.

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1500 GOOD TOOLS

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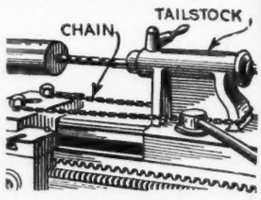

WHEN drilling deep holes in a lathe, the drill usually is fed by hand and on extra long work it is necessary to change the position of the tailstock several times. While this is all right for drilling one or two pieces, it involves a considerable loss of time when there are a number of similar pieces.

In such a case, time may be saved by rigging the lathe as shown so that the carriage will pull the tailstock along with the power feed.—F. J. W.

Die-Making Simplified

(*Continued from page 96*)

drawing or cupping of sheet-metal into intricate shapes has opened up a field of work that seems unlimited. The shapes that were obtainable only by spinning a few years ago, today are made much more cheaply in drawing dies.

When it is necessary to make deep drawn work—that is, deep in proportion to the diameter—it is necessary to do the drawing in two or more dies. This is because the metal hardens in the drawing and it is necessary to anneal the cups between operations.

On plated stock, such as tinware is made from, annealing is impossible, but if the stock has been properly annealed by the manufacturer and the tools well designed, reasonably deep draws are possible.

The ordinary shoe-polish can is an example of the product of the combination die. A section of one is shown in Fig. 11 and it will be noted how compact is the design. The shoe contains a tool-steel cutting edge and die center. Around the latter is a pressure ring. This ring is held flush with the cutting edge by a pressure pad containing three pins, which are forced up by a compressed rubber pad on a stud below the press. The punch contains a knockout pad with a stem projecting through the shank of the punch. A suitable locating gage and stripper (not shown) are used.

This die is operated as follows: When the punch comes down on the stock, it cuts the blank and at the same time grips the blank between the face of the punch and the pressure ring. As the punch continues down, the pressure ring also is forced down, thus compressing the rubber pad, which has exerted enough pressure on the blank so that it could not wrinkle while being drawn into a cup. When all the stock has been drawn over the die center and the punch starts on its upward trip, the pressure ring strips the cup from the center so that it is carried up in the punch. As the punch nears the end of its stroke, the stem of the knockout comes in contact with a stop, thus forcing the cup from the punch.

The rapid strides that have been made in the past few years in die work make it advisable for the average machinist to familiarize himself with this line of work, as many of the jobs that were made in the past in some form of machine tool are now being made in the punch press.

COLGATE'S
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"HANDY GRIP" AND REFILL

for Comfort, Convenience and Economy

When we say to you that the Shaving Stick has important advantages over shaving preparations in any other form, we can do so without bias, for we manufacture shaving sticks, powder and cream.

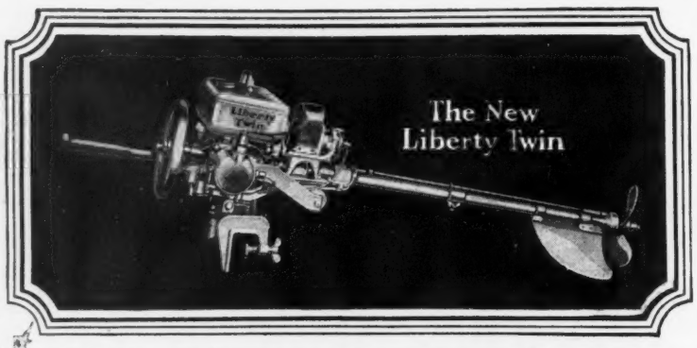
In its attractive nickel box, our "Handy Grip" Shaving Stick is most convenient for traveling. It will not crush when packed, and it makes a wonderful lather for *easy* shaving. It is not uncommon for a Colgate Shaving Stick to last more than a year in daily use.

The famous "Handy Grip", with a trial-size shaving stick in nickel box, sent for 10c. When the trial stick is gone, buy Colgate "Refills" for the price of the soap alone, 25c.

COLGATE & CO. *Established 1806* NEW YORK

Beautifully finished with nickel trimmings

A motor you will be proud to own



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EVERY desirable rowboat motor feature that you have ever heard of is embodied in the Caille Liberty Twin. It has twin cylinders, light weight, direct drive, Bosch ignition, Zenith carburetor, motor cycle control, plenty of power, is speedy and the motor does not vibrate. What more can you ask? No other motor can follow the

CAILLE LIBERTY TWIN DETROIT

through weeds, shallows and over hidden obstructions that would damage any other so-called "tilting motor." The Caille direct drive principle has proven its correctness to thousands of users over a period of four years. The power is transmitted direct to the propeller. Has no bevel gears to waste power and give trouble. Our challenge to other builders to follow us through weeds, shallows and over sunken obstructions has never been accepted and still stands.

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Rowboat Motors

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Gentlemen:
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Name.....

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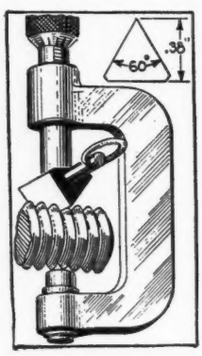
Simple Inspection Gage for Testing Thread Sizes

By George A. Luers
Automotive and Mechanical Engineer

WHILE a number of methods for measuring the threads of screw parts are in use, one of the simplest possible ways is by means of an ordinary micrometer and the triangular steel block illustrated. With this combination the thread size may be obtained with an accuracy limited only by the accuracy of the micrometer, even as close as .0001 in. In one nationally known manufacturing plant this largely has superseded other screw-gaging methods.

The gage piece is accurately ground tool steel with an included angle between the surfaces of 60 degrees and an altitude of .38 in. from the base to the apex of the opposite angle. A ring is attached to one end to enable it to be handled and carried more readily. Two edges of the gage are chamfered, as shown, for use with the U. S. Standard and A. S. M. E. threads.



Gage block used with micrometer

In use, the gage and screw to be measured are placed as shown. If a U. S. S. thread is being tested, the micrometer reading is compared by using the following formula:

$$\text{Outside diameter} = \text{micrometer reading} - .38 + \frac{.7577}{\text{Threads to the inch}}$$

As an example, take a standard machine screw having 14 threads to the inch. The micrometer reads .7759 in. Substituting in the formula we find an external diameter of .45 for the screw. This is the actual maximum value allowed for this size and type thread and the screw is therefore accurate. The constant is obtained by adding to the thread depth, which is .6495 in., the value .10825, which is the depth of a V thread having a width equal to the flat at the bottom of the thread.

Where V threads are being tested, the same formula is used excepting that the constant used is .866 instead of .7577.

The method is applicable to large and small screws. Instead of working out the formula every time a screw is tested, it is possible to make out a table that will give the results immediately. In that case it is just as well to arrange the formula in the following order:

$$\text{Micrometer reading} = \text{outside diameter} - \frac{.7577 \text{ (or } .866)}{\text{Threads to the in.}} + .38 \text{ in.}$$

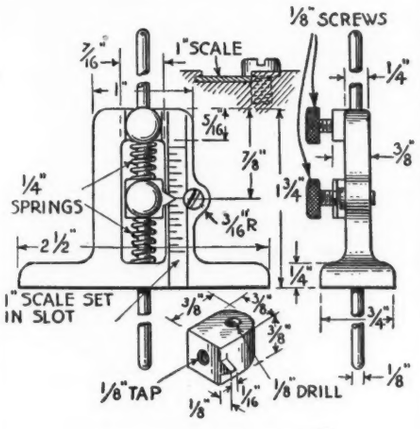
A glance at the table then shows whether or not the actual micrometer reading is what it should be, without considering the steps by which the result has been worked out.

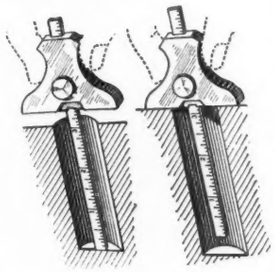
TO COPPERIZE brass, first wet with bluestone solution and then rub with some fine iron filings.

Indicating Depth Gage Shows Amount of Error Automatically

THE usual depth gage does not indicate the amount yet to be cut or the amount of the overcut in holes or slots being machined. This indicating gage will do both. It therefore aids in obtaining the exact depth required with fewer trials than are ordinarily necessary.

The gage is first set for the exact amount. Then, when the approximate depth is reached, the scale is placed in the hole and the holder is pressed down as far as it will go. The variation in the scale reading gives the distance to go.



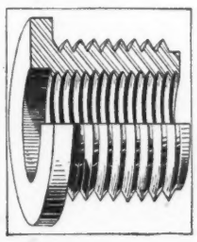


Details of the indicating depth gage (above) and method of using it (at right). If hole or slot is not deep enough or is too deep, the pointer shows the difference

If the hole is already too deep, pressing on the rod will cause it to move down, and again the scale reading will indicate the error. The spring automatically returns the rod to its original position of zero reading.—HENRY S. LARABY.

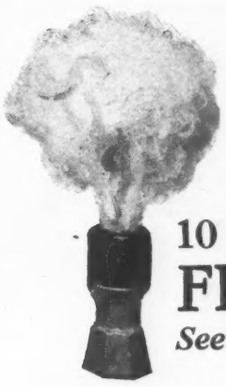
Lathe Chuck Adapter

IN SMALL shops having only two or three lathes, each of a different size, it is sometimes desired to use a chuck of one lathe on another. The illustration shows an adapter for this purpose. It is made from mild tool steel and threaded inside and out to suit the lathes for which it is intended. The outer threads should be cut while it is screwed on the lathe spindle to insure its running true.—H. L. W.



Bending Pipes by Hand

TO BEND pipes by hand without special tools, fill the pipe with dry sand, plug or cap the ends to retain the filling, and heat the pipe at the point where it is to be bent.



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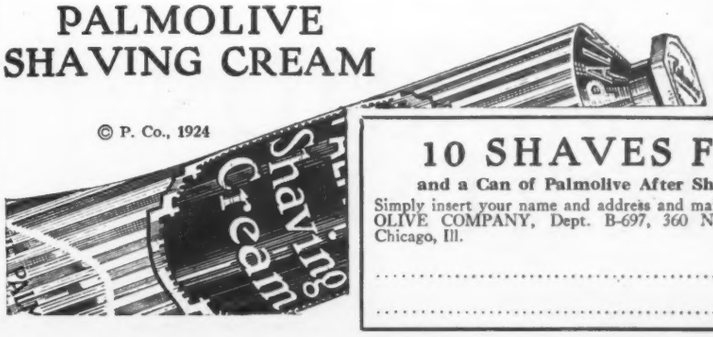

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Feeler Block Gage for Setting Straddle Milling Cutters

IN SETTING up cutters and adjusting a fixture in straddle milling operations, a feeler block gage, made as illustrated, saves considerable time and insures accuracy.

The work, in this case shown as a plain block, is mounted in any convenient manner on whatever type of fixture is

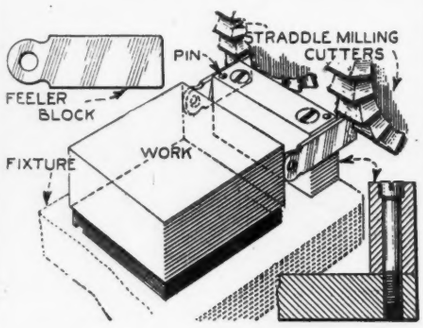


Diagram showing how the gage block and feeler blocks are used to insure accuracy

used. Screwed and doweled to the base of the fixture is a block 1/16 in. narrower on each side than the required distance between the cutters or finished width of the work. The feeler blocks are separate hardened and ground gages 1/16 in. thick. They are used in connection with the fixed block to determine the distance between the cutters.

With this device cutters can be set up for repeat runs at any time and the operator is sure of the work's being right.—W. BURR BENNETT, Bloomfield, N. J.

Calipering Holes while Boring

THE difficulty of calipering a hole that is being bored with a boring bar is largely overcome by bending the legs of the calipers at an angle of about 45 degrees. The bend should be made an inch or two from the ends.—J. A.

Compressed-Air Whistle Used for Factory Call System

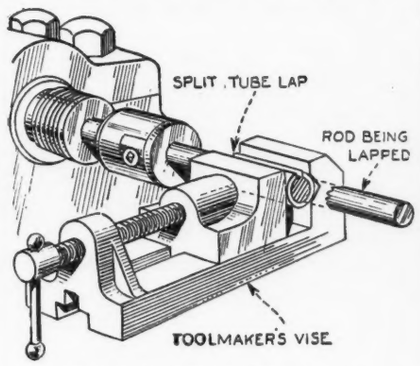
AN EFFECTIVE factory call system can be installed cheaply in any plant that uses an ordinary air compressor. On the compressor is mounted a small whistle of the kind often used on automobile trucks. A rope leads from the whistle in the shop to a position convenient to the man in the office who greets callers.

In one plant where this system is used, a code has been devised—one blast of the whistle for the manager, two blasts for the superintendent, and so on. If the official of the company happens to be out in the shop when a caller arrives, the office man without leaving his desk gives the proper number of tugs on the rope, and the blasts of the whistle are loud enough to be heard anywhere in the shop.

The idea is especially well adapted to shops where there is considerable noise so that the ringing of an ordinary electric bell operated by a pushbutton would not be heard.—JOHN MATTER, Marion, Ind.

Vise Used in Lapping Hardened Steel Rods and Pins

THE most difficult part of a lapping job, where hardened steel rods and pins are to be lapped a few thousandths of an inch in a lathe, is the locating of the lap. This can be eliminated by using, as shown, a length of split brass tubing of a diameter that will allow the rod or pin to



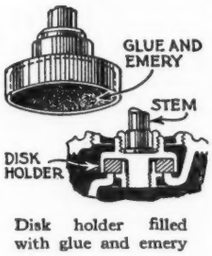
The lap, which is a split brass tube, is held in a toolmaker's vise

enter freely. The tube is held in a toolmaker's vise, and, after the rod is inserted, the rear jaw is tightened. The vise then is moved back and forth over the rod and fine emery and oil, or valve-grinding compound, is used as an abrasive. As the lap wears down, the jaw is tightened to close the tubing on the rod.—JOE V. ROMIG.

Globe Valve Seat Grinder

A TOOL for refacing the brass seats of common types of globe valves can be made as illustrated for a few cents in half an hour. It serves fairly well in place of special tools, which in the larger sizes are quite expensive.

Remove the composition or metal disk from its holder and fill the space with a paste of thin glue and emery powder, using as much powder as the glue will take up. Level the top while it is damp and set aside to harden. Unscrew the stem from the valve with the holder attached, place the stem in a carpenter's brace and use it to reface the seat. See that the valve is dry so that the glue will not be softened or dissolved.



Disk holder filled with glue and emery

When ready to replace the valve stem, soak it in hot water for a few minutes and the glue and emery will melt. I have made a first class job of refacing 3- and 4-in. valves by this method. A regular grinder for these sizes costs, I understand, about $25.—JAMES E. NOBLE, Toronto, Canada.

A NUMBER of lathe shortcuts used by expert mechanics and a feature article, "Getting the Most Out of a Lathe," are scheduled for early publication in the Better Shop Methods Department.

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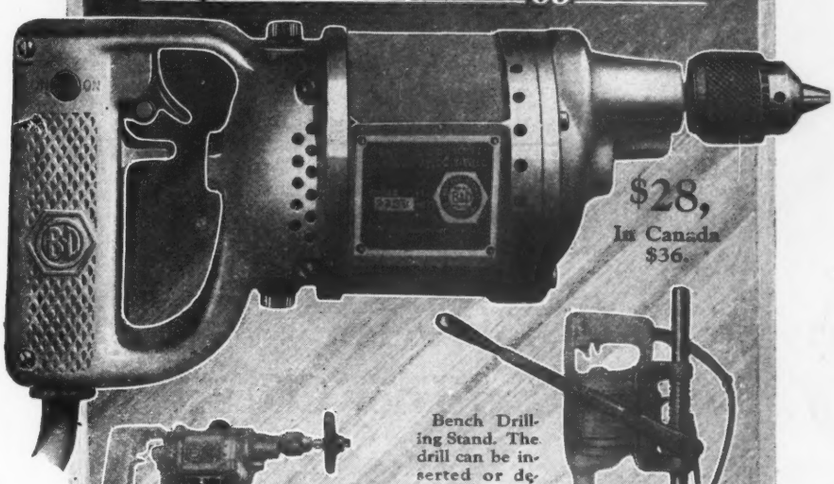

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Grinding Outfit.—Consists of stand which can be fastened to bench top, arbor with clamp washers and nut, and grinding wheel. $3—In Canada $4

Bench Drilling Stand. The drill can be inserted or detached quickly by means of handle clamp. $12, In Canada $16

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How Many Holes Do You Bore—Stop and Think!

IF YOU ask a mechanic what tool in his kit he uses most he is apt to name a hammer, wrench or screwdriver, BUT when you stop to think about it, you realize that the good cabinet maker never thinks of driving a nail without first boring for it (except in soft wood or very rough work)—that when you use a wrench for drawing up a nut a hole must have been drilled for the bolt or stud—that no good mechanic would think of driving a screw without first boring a lead hole.

In addition millions of holes are drilled for electric wires, cotter pins, dowels, for outlining large holes in sheet metal, for radio panels and hundreds of other uses.

WHY USE OLD FASHIONED HAND BORING MACHINES, WHEN YOU CAN BUY FOR $28.00 AN ELECTRIC MOTOR DRIVEN TOOL THAT WILL DO THE WORK FASTER, MORE ACCURATELY, AND WITH LESS PHYSICAL EXERTION?

All good mechanics realize that it does not pay to have anything but the best tools, but until recently a good electric drill was beyond the means of the average man. (A year and a half ago this drill cost $65.00.) Now, however, because of the ever increasing demand, these tools are being manufactured on a quantity production basis, as the result of which the BLACK & DECKER QUARTER INCH DRILL, which is the choice of most experienced mechanics, can be obtained for only $28.00.

Then, when you consider that you can not only drill holes with this tool, but, by using the inexpensive attachments shown, can do grinding, buffing and wire brushing work, and that you can have a home drill press by using the Bench Drill Stand, you begin to wonder whether the portable electric drill isn't the most important tool in the kit.

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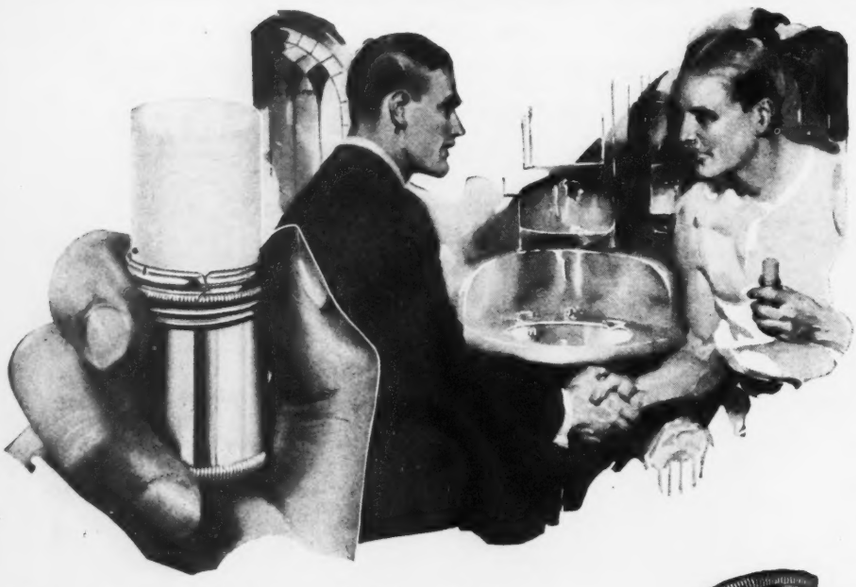
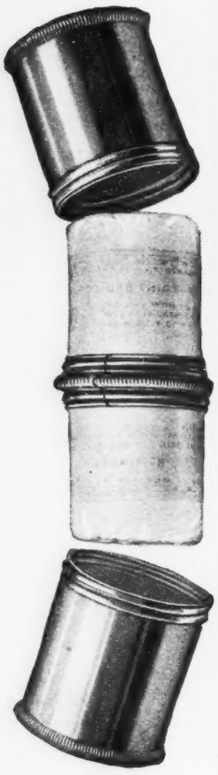


Shaving Sticks, Like Men, *Differ* in the Grasp They Offer



This new Williams stick offers you a *man's* grasp—totally different from the finger-tip hold of other shaving sticks.

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Williams Re-Loads cost less than the original package. The metal Doublecap container lasts indefinitely. It is highly polished, non-corrosive, a fit neighbor for your handsomest silver toilet articles.

The soap in Doublecap gives that same famous shave for which Williams is noted—heavier, "never-say-dry" lather, and delightful after-care of the skin. You'll find Doublecap the perfect stick in the perfect container.

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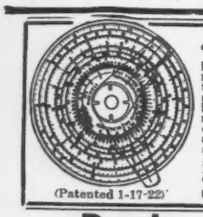

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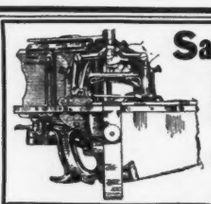

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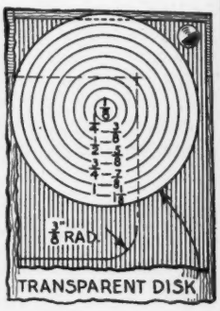
Radii Center Finder Speeds Up Mechanical Drawing

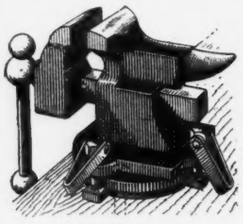


TO DETERMINE a suitable radius and locate its center in laying out mechanical drawings, a radius templet may be made by scratching a number of concentric circles on a lightweight celluloid disk. The circles are filled with black drawing ink and a pinhole is drilled in the center for locating the center of curvature.—C. M. WILCOX.

Fitting a Swivel Base to a Plain Bench Vise

A BENCH vise with a plain base, which cannot be swiveled into the most convenient position for working, usually can be fitted with a swivel base without much difficulty.

Two disks of iron or steel plate, about ⅜ in. thick are provided, one to fit inside the edges of the bolt holes in the vise base and the other about 1 in. less in diameter. The disks are bolted jointly to the bench top. The vise is fastened to them with bolts and square nuts, the nuts catching beneath the upper of the two disks.

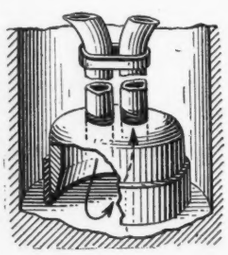


Two disks form the swivel base

A small swing handle, made from a strip of steel and a pin, is added to the head of each of the bolts. The vise then can be swung around and locked in any position desired.—G. L.

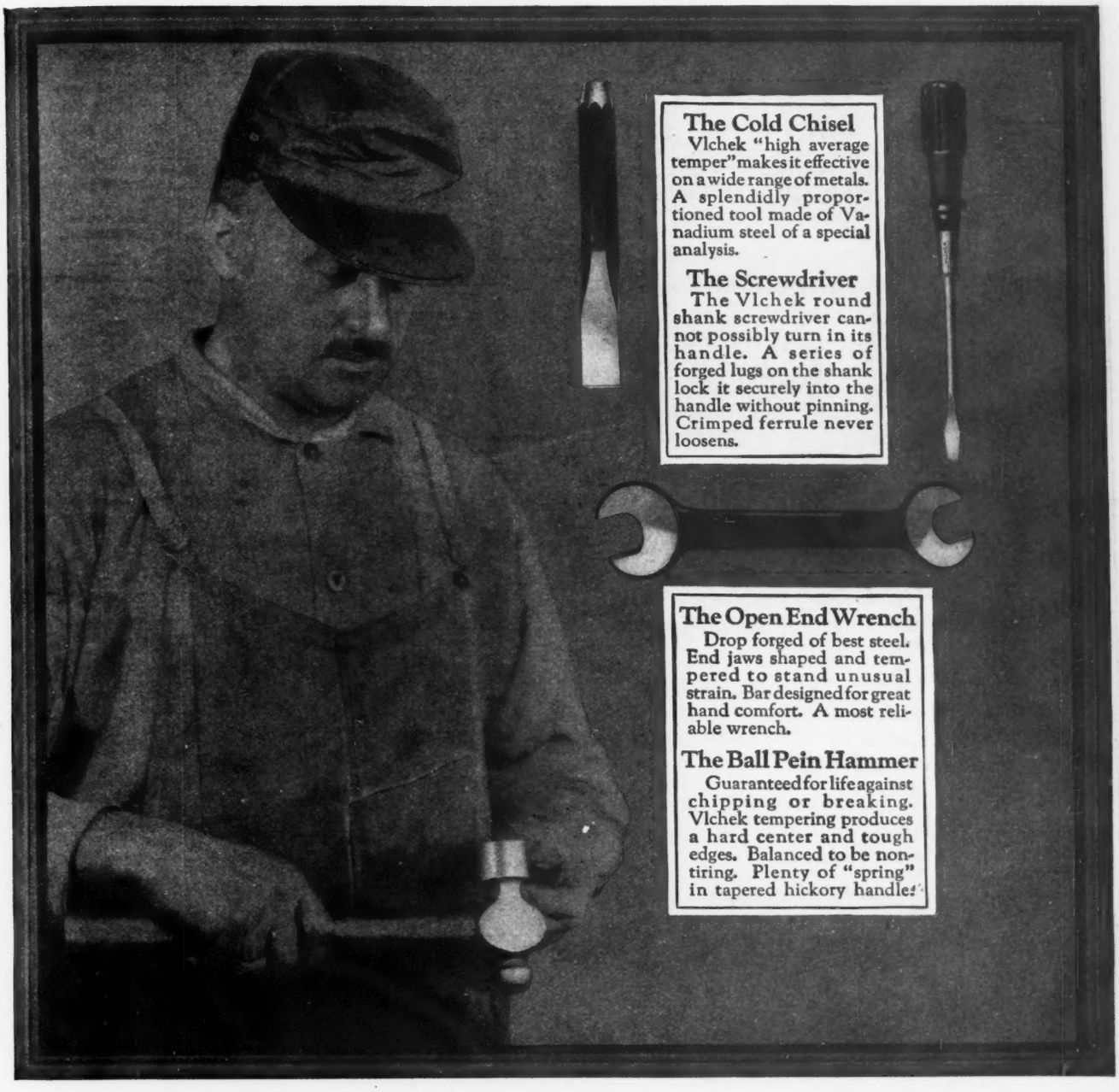
Chip Blower for Deep Holes

STONE cutters and mechanics often have difficulty in removing chips and dust from the bottom of holes that are very wide or too deep for the common type of blower to operate. An effective chip blower for such work can be made as illustrated. The cup can be made from a pipe cap by first turning the threads out on a lathe and tapering the edge. A rubber skirt is attached at the lower edge. Two brass tubes are inserted in the cup, being either threaded or soldered to it and a band may be soldered around the tubes near the top to give added strength.



The air cup has a rubber skirt

Air blown into one tube picks up the dust and chips and carries them out of the other.—C. A. MARTIN, Lewisburg, Pa.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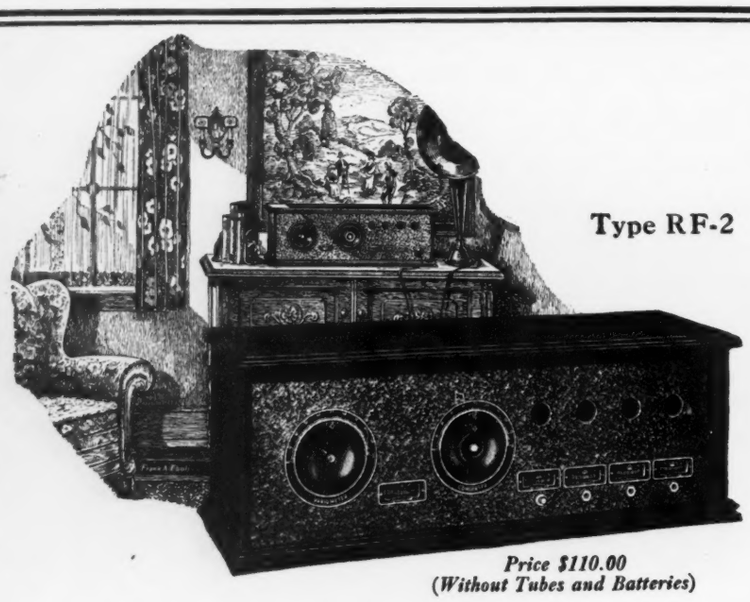

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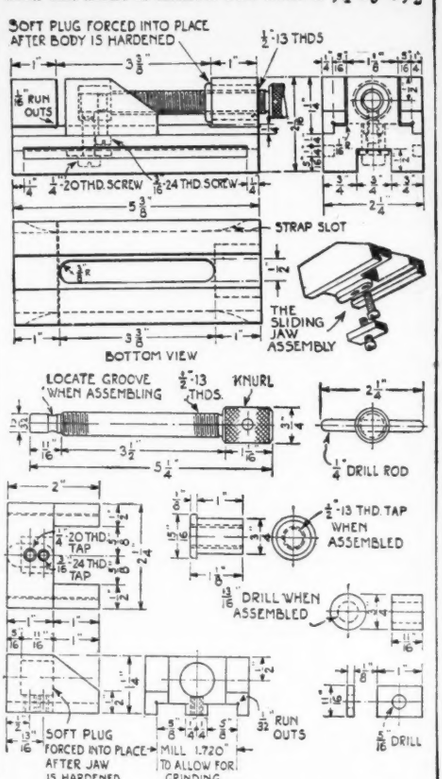
Toolmaker's Accurate Hand Vise Has Renewable Threads

THE toolmaker's hand vise illustrated has several marked advantages over the type ordinarily designed and made by mechanics for their own use. The slideway on the bottom slide runs out at each end, so that it is possible to finish the vise all over before grinding. Furthermore, the screw can be made a snug fit so that the jaw will slide without binding and have almost no play sideways and up and down, as is unavoidable in vises where it is impossible to line up the screw perfectly. The soft plugs provide an easy method of renewing the thread if it should be spoiled in any way or should not line up.

The machine steel vise body, 2 1/16 by 2¼ by 5⅜ in., is ground square all over, and the slide is milled out with a ¾ by 3½



How the vise is assembled and details of the jaws, screw and other parts

in. side cutter, which also is used to mill the body post. The fillets in the body post are milled with a 1/16-in. radius at the corner. The middle slot in the body then is drilled out with a 7/16-in. drill and milled with a 7/16-in. end mill and a vertical head. The bottom slide is milled ¾ in. wide and ½ in. deep, with a ½ by 3 in. side cutter, the work being reversed to cut the slot central.

The jaw slide and the strap slots are cut with a ¼ by 3 in. side cutter. The runouts are cut 1/16 in. wide and about 1/16 to 1 in. deep with a 1/16-in. saw, the body of the work being tilted at 45 degrees. The work is then fastened to a lathe faceplate against an angle iron and the post drilled with a ⅝-in. drill and bored to ¾ in.

Following a somewhat similar process, the vise jaw, 1¼ by 2 by 2¼ in., is ground square all over, the bevel is cut with a

(Continued on page 107)

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Toolmaker's Accurate Hand Vise

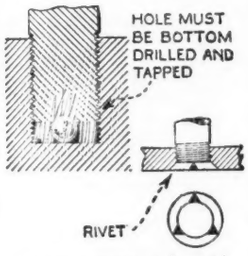
(*Continued from page 106*)

1¾-in. slab miller, the screw slot is milled with a ¾ by 3½ in. side cutter, the run-outs are made with a 1/32-in. saw, and the hole for the soft plug is bored in the lathe ¾ in. in diameter and 11/16 in. deep, with a square bottom. One of the screw holes is drilled as shown with a No. 34 drill and tapped 3/16 in.—24 thd.; the other is drilled with a No. 12 drill and tapped ¼ in.—20 thd.

The soft plugs are forced into place in an arbor press after the jaw and body are hardened. Then the body and jaw are ground all over. The jaw is made a snug sliding fit in the body slide, after which the jaw and the body post are bored and the latter is threaded for a ½-in. No. 13 U.S.S. thread. This procedure is as follows: Set up the work against an angle iron on the lathe faceplate, drill through the plug with a 5/16-in. drill 1¼ in. deep, bore the hole to the diameter of the bottom of the thread .4 in., boring until the tool touches the hardened jaw; remove the sliding jaw and thread the body post plug. For an especially fine finish, lap the body and jaw on a lapping plate.

Holding Studs Securely

STUDS with wingnuts that are constantly in use, as on jigs and fixtures, soon work loose, even if pinned in place. The following are two methods I use to keep the studs tight: In heavy material, drill a hole into the end of the stud about half the stud's diameter and an equal depth, and countersink the hole. Next, drop a steel ball about 1/16 in. larger than this hole into the tapped hole for the stud and tighten the stud in place. The steel ball causes the threads to expand.

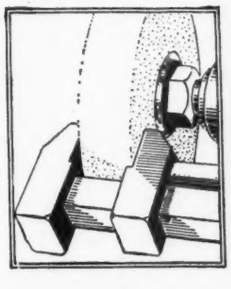


In heavy material (at left); in metal plate (at right)

Where the stud is to be held in a thin metal plate, countersink the bottom of the hole rather obtusely and, with a diamond-point chisel, cut three or four grooves down the sides of the countersunk part of the hole, starting with almost nothing and cutting in deep toward the center. Screw the stud in place and rivet it over firmly.

Grinding Wrench Jaws

RECENTLY I saw an old machinist pick up a monkey wrench that had been discarded because of the battered condition of the jaws, and true them up on an emery wheel, as shown. Although this took only a few minutes, the tool was restored to usefulness.



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to represent us in the direct sale of a pipe wrench which embodies a new principle and represents the first real improvement in this tool. Now approved and in general use by some of the largest corporations. Sells on sight. If interested, send $1.75 (cash or money-order) for 10" sample and full particulars. This is a real opportunity.
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"WONDER" COLD PIPE, TUBING & BAR BENDERS
Standard of the World
HAND and MOTOR OPERATED
14 Sizes of Machines
What it costs to bend pipe our way. Per bend.
1" pipe 5 cents 4" pipe 25 cents
2" pipe 10 cents 6" pipe 60 cents
3" pipe $1.00
Send for Catalogue.
AMERICAN PIPE BENDING MACHINE CO.
51 Pearl St. Boston, Mass.

Why Puzzle?

THE time you waste hunting through a heap of assorted styles of wrenches will pay for a Kit of Snap-ons—real, husky interchangeable socket wrenches, hand-picked by experts for your own car. To tighten this or loosen that, just snap the right-sized Snap-on socket, found in a jiffy, on a Snap-on handle and go to it.

Here's a typical Snap-on selected Kit — a handful of special-steel units that do more work easier than 60 old-style wrenches at a fraction of their cost. A few dollars will buy a Kit for your car. Just fill out the coupon and we'll send full details.

Snap-on
INTERCHANGEABLE
Socket Wrenches

MOTOR TOOL SPECIALTY CO.,
14 E. Jackson Blvd., CHICAGO.

Gentlemen:
Please send me full particulars about Snap-on Kit for.....car. (If interested in Master Mechanic's Kit, check here .....)

I buy tools from.....

Name.....

Address.....

Attractive Rocking-Chair Easily Made

By Stanley W. Blanchard

THIS comfortable rocking-chair is the companion piece to the upright habitant chair described in the April issue of POPULAR SCIENCE MONTHLY.

It is a more ambitious project than the other chair, as there are several joints to be made at different angles; but it is well within the reach of any amateur woodworker who takes care in his work.

The enduring charm of this chair lies in its simplicity and its unusually good proportions

First cut out the back legs, the front legs, and the rockers after laying out the parts to cut with as little waste as possible. To have these pieces cut at a mill on a bandsaw is not expensive and it eliminates the hardest physical part of the work.

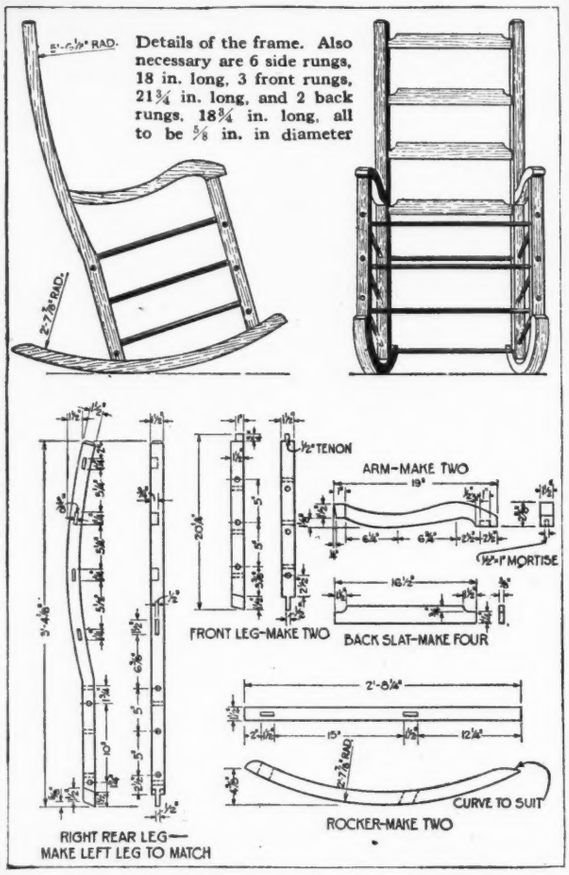
Bore the ⅝-in. holes in the front and back legs for the side rungs only. These holes are bored straight through at right angles to the front of the legs and not at an odd angle, as are the holes for the front and back rungs.

FASTEN a back and a front leg together by driving the rungs into place. This will hold the legs in their respective positions so that the rocker may be laid in its place at the ends of the legs and the shoulder of the tenon marked where the rocker crosses the legs. Then put the rocker under the legs and obtain the lines for the direction of the mortise through the rocker by marking where the leg crosses the rocker. The four mortise-and-tenon joints are now cut out and fitted. The arm is fitted into place in the same manner, except the joint in front, which is a plain right angle.

The two sides now being framed, the next step is to put in the front and back rungs and the back slats. Note that the holes for the front and back rungs must be bored at an angle to allow for the fact that the chair is narrower at the back than at the front. When boring, make a guide for your bit out of a few scraps of wood, or the holes may be bored with the aid of the eye alone if you are well practised.

CUT the mortises in the back legs for the slats and then assemble the chair, using strong glue and pinning the tenons into place with a ¼-in. dowel, if you wish to increase the strength.

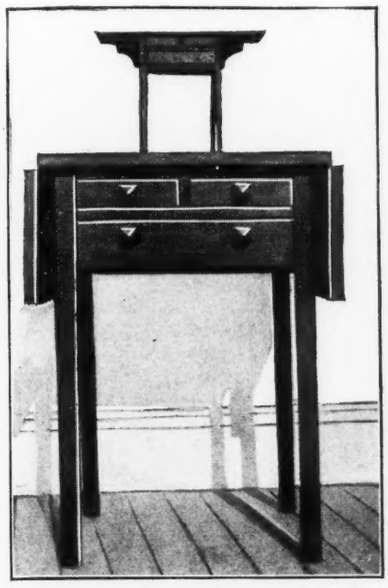
After the glue has dried for about 24 hours, scrape and sand the chair, finish as you please and then put in the seat as explained on page 82 of the April POPULAR SCIENCE MONTHLY.


Details of the frame. Also necessary are 6 side rungs, 18 in. long, 3 front rungs, 21¾ in. long, and 2 back rungs, 18¾ in. long, all to be ⅝ in. in diameter
½" TENON
ARM—MAKE TWO
½"-1" MORTISE
FRONT LEG—MAKE TWO
BACK SLAT—MAKE FOUR
CURVE TO SUIT
ROCKER—MAKE TWO
RIGHT REAR LEG—
MAKE LEFT LEG TO MATCH

Friction Tape Serves as Belt for Small Motor

ORDINARY tire tape sometimes may be used to advantage as a belt for small power-driven devices. For instance, I found it hard to make a short belt drive a small centrifugal pump operated by a ¼-hp. electric motor. I wrapped both pulleys with a single thickness of the tire tape and then took the tape and drew it around the pulleys, making only one turn, but allowing about 2 ft. for overlapping. I pasted the tape firmly where it lapped. One thickness of tape runs the pump at 6000 revolutions and the friction previously due to a tight belt is eliminated.—F. H. HERTZLER.

Home Workshop Sewing Table Maintains Its Popularity



Sewing table and a one-third scale toy model made from Home Workshop blueprint

THE first Home Workshop blueprint published by POPULAR SCIENCE MONTHLY, which gives the working details of a sewing table, continues in de-

(*Continued on page 110*)

Complete List of Blueprints

ANY one of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to provide, upon request, information relative to tools, material, or equipment.

Blueprint Service Dept.
Popular Science Monthly
225 West 39th St., New York.

GENTLEMEN:

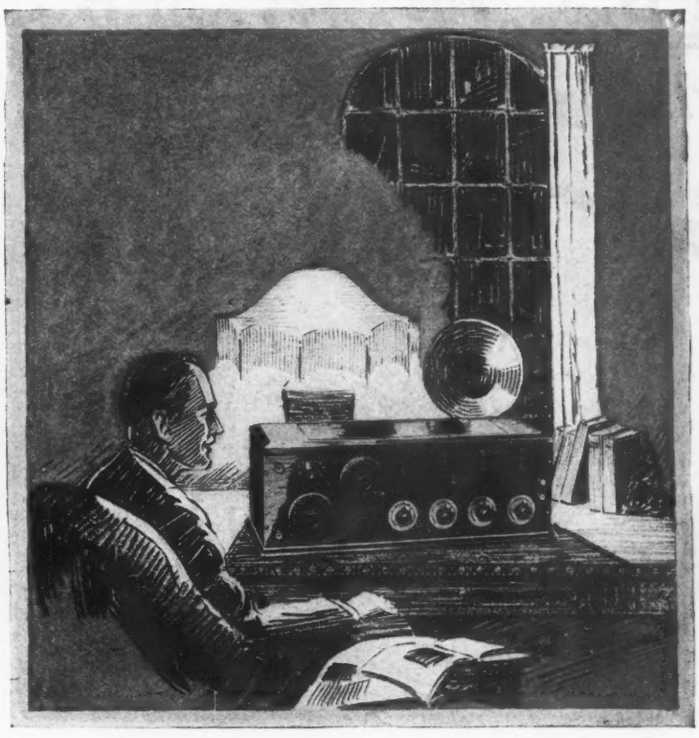
Send me the blueprint, or blueprints, I have underlined below, for which I inclose.....cents:

No.	*Title*	*Price*
1.	Sewing Table	25c
2.	Smoking Cabinet	25c
3.	Book Trough End Table	25c
5.	Kitchen Cabinet	25c
6.	Two-Stage Radio Receiving Set	25c
8.	Shaving Cabinet	25c
9.	Arbor with Gate and Seats	25c
10.	Porch Swing	25c
11.	Bench and Tilt-Top Table	25c
12.	Electric Washing Machine	25c
13.	Tea Wagon	25c
14.	Toy Train, Horse, and House	25c
15.	Home Workshop Bench	25c
16.	Inlaid Radio Cabinet	25c
17.	Cedar and Mahogany Chest	25c
18.	Telephone Table and Stool	25c
19.	Grandfather's Clock	25c
20.	Flat Top Desk	25c
21.	Colonial Writing Desk	25c
22.	Girl's Cabinet and Desk	25c
23.	Pergola Garage	25c
24.	Gateleg Table	25c
25.	Sailing Outfit for Canoe	25c
26.	Baby's Crib and Play Pen	25c
27.	Kitchen Cabinet Work Table	25c
28.	Pullman Play Table	25c
29.	Toy Tea Cart, Garage, etc	25c
30.	Tool Cabinet, Bench Hook, etc	25c
31.	Priscilla Sewing Cabinets	25c
32.	Chinese Game Table	25c
33.	Pullman Dining Alcove	25c
34.	Trellises for House and Garden	25c

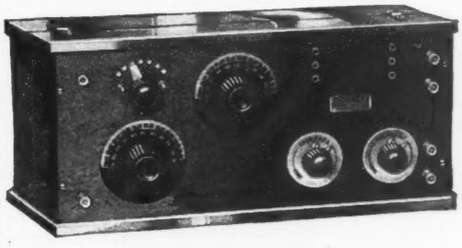
Name .....
(Please print)

Street.....

City and State.....



Every One Can Now Own a Quality Radio Set



This is Model K—the much-talked of outfit with which Mr. E. D. Elliott, of Milford, New York, got London, England; Fairbanks, Alaska; La Palma, Panama; San Francisco, Los Angeles and about 122 other long distance stations.

It's a two-tube outfit that sells for only.. **$29.50**

MODEL M W

Shown in the illustration at the top of the page is our 4-tube outfit that can be used with a loud speaker. It sells for only $54.50.

Write for Bulletin

These two Improved Miraco models make it possible for every family to own their own set—to have a choice seat for the opera or symphony or jazz concert right in their own living room.

Improvements and refinements that appear in expensive sets only are built in each and every MIRACO. In other words, *highest quality* at the *lowest price* has been solely responsible for the sale of thousands of our sets that are bringing radio-joy to each and every family who own one. Users of Miraco sets report getting as many as fifty stations in one evening.

The cabinets are of solid mahogany and workmanship is unexcelled. Easy and simple to operate and always dependable. Fully GUARANTEED against any defects in workmanship.

Write for our new bulletin TODAY

DEALERS—JOBBERS

Write for proposition quickly

AGENTS

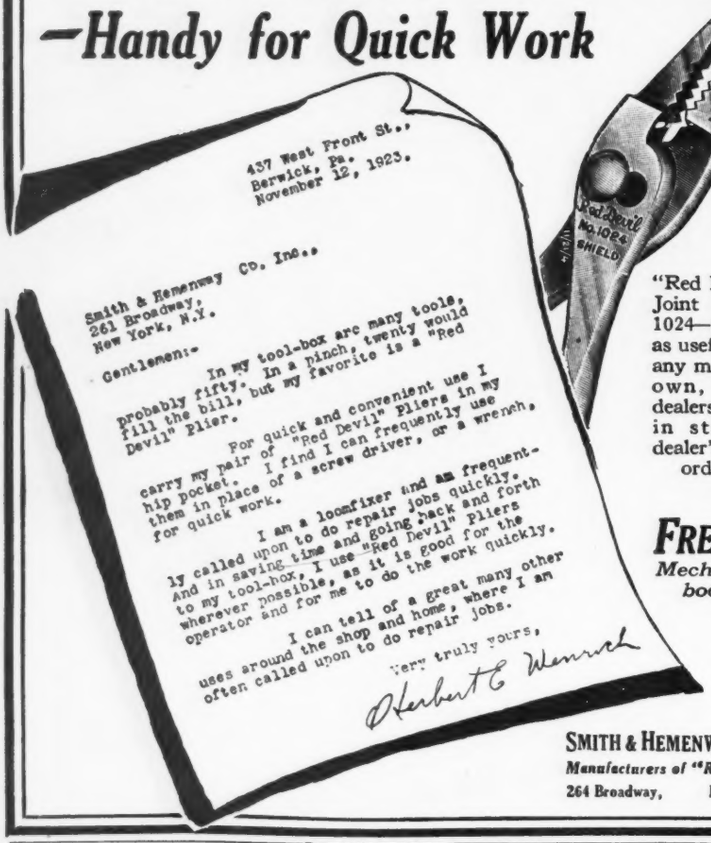
There's still some territory open—write or wire

THE MIDWEST RADIO COMPANY

808 Main Street, Cincinnati, Ohio

The Improved MIRACO

A Pair of "Red Devil" Pliers —Handy for Quick Work

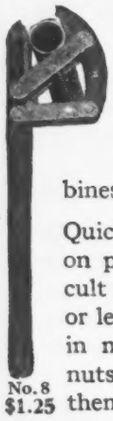

437 West Front St.,
Berwick, Pa.
November 12, 1923.
Smith & Hemenway Co. Inc.,
261 Broadway,
New York, N.Y.
Gentlemen:-
In my tool-box are many tools,
Probably fifty. In a pinch, twenty would
fill the bill, but my favorite is a "Red
Devil" Plier.
For quick and convenient use I
carry my pair of "Red Devil" Pliers in my
hip pocket. I find I can frequently use
them in place of a screw driver, or a wrench,
for quick work.
I am a loomfixer and am frequent-
ly called upon to do repair jobs quickly.
And in saving time and going back and forth
to my tool-box, I use "Red Devil" Pliers
wherever possible, as it is good for the
operator and for me to do the work quickly.
I can tell of a great many other
uses around the shop and home, where I am
often called upon to do repair jobs.
Very truly yours,
Herbert C. Wenrich
Red Devil
No. 1024
SHIELD

"Red Devil" Slip Joint Pliers No. 1024—6½"—about as useful a tool as any mechanic can own, $1.10 at dealers, or if not in stock, send dealer's name and order direct.

FREE: *"Red Devil" Mechanic's tool booklet.*

SMITH & HEMENWAY CO., INC.,
Manufacturers of "Red Devil" Tools
264 Broadway, New York, N. Y.

The All Purpose Hoe Wrench



No. 8
$1.25

Everywhere you can use a wrench you can use a HOE. No wrench has ever before been manufactured that combines so many advantages.

Quickly and easily put on pipes. Grips in difficult places, will not slip or let go. Does not clog in mud or sand. Grips nuts square and holds them.

Manufactured of the best and strongest materials obtainable. Fully guaranteed. Order through your local dealer or direct from the factory. The HOE is Strong, the HOE is Durable, the HOE is Simple.

Use It and Prove It

Hoe Corporation
Poughkeepsie, New York

At last! a 100% Woodworker

Only $225.00
complete with motor

8 inch Circular rip saw
8 inch Circular cross cut saw
11 inch Band saw
4 inch Jointer Shaper
10 inch sander
lathe—14 inch swing

PARKS Cabinet Shop Special is absolutely the most complete small shop equipment you can buy! Everything in one compact unit with motor!

Just the machine for your home shop—for the cabinet maker—novelty and toy-maker—special furniture builder—for the farmer who makes his own crates, bee-hives, etc. No end to its usefulness!

Complete, or without motor and attachments to suit your needs.

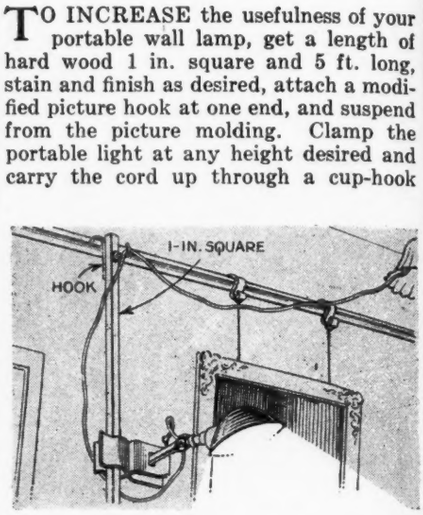
Write for circular

The Parks Ball Bearing Machine Company
1547 Knowlton St., Cincinnati, O.
Canadian Factory: 200 Notre Dame East, Montreal, Can.

PARKS
WOODWORKING MACHINES

A Portable Electric Lamp Hung from the Picture Molding

TO INCREASE the usefulness of your portable wall lamp, get a length of hard wood 1 in. square and 5 ft. long, stain and finish as desired, attach a modified picture hook at one end, and suspend from the picture molding. Clamp the portable light at any height desired and carry the cord up through a cup-hook



The lamp can be hung anywhere in the room and placed at any height

screwed to the top end of stick and continue over to the electrolier.

Rooms where the portable is used most frequently seldom have wall sockets for plugging in, but with this device the cord is inconspicuous and out of harm's way. There is no necessity for marring walls or woodwork with screws; the danger of scratching bed frames or highly polished furniture by direct clamping is eliminated, and it permits shifting the light to any height and to any part of the room with ease and safety. For subdued or indirect light the lamp can be turned up toward the ceiling.—H. G. WEEKS, Colorado Springs, Colo.

Home Workshop Sewing Table

(*Continued from page 109*)

mand among amateur woodworkers. The original tracing has gone through the blueprinting machine so many hundreds of times that it will soon have to be replaced or the number withdrawn. But copies are still available for those who fill out the coupon on the preceding page.

A table made from one of these blueprints by H. N. Aldrich, a banker of Rosalie, Neb., is illustrated at the top of that page. Mr. Aldrich writes as follows:

I am herewith sending you a photograph of the sewing table made under your blueprint No. 1, or rather two tables, one of which is a one-third scale model made as a Christmas present for my daughter.

Right here and now I want to express my appreciation for the service of your department.

The photograph really does not do justice to the table. It was made from South American mahogany, polished, with hardware of brass and nickel. The pieces were all cut to measure before assembling and so good was the blueprint that not one bit of cut-and-fit carpentry was necessary.

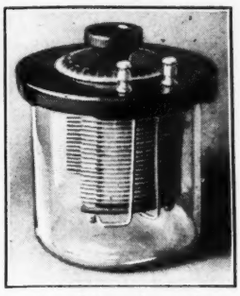
The table cost me in the neighborhood of $10, which is a good investment in comparison with the price of the same article factory built, which is much inferior.

An equally interesting photograph of an arbor built from Blueprint No. 9 will be shown next month, followed by other illustrations of readers' craftwork.

Glass Protects Radio Condenser from Dust and Moisture

TO THE radio experimenter a glass-inclosed condenser is invaluable. An ordinary radio condenser can be converted into one of the inclosed type with nothing more than a 1- or 1½-quart jar and an old phonograph record.

The top of the jar is cut off by wetting a fairly heavy piece of cord in alcohol, tying it around the jar at the point where it is to be cut, setting fire to the cord and, when the flame has reached its height, plunging the jar into a bucket of cold water. If you have never tried this trick before, experiment on some old jars first. Be careful not to smear any surplus alcohol over the jar.



A useful condenser for experimental purposes

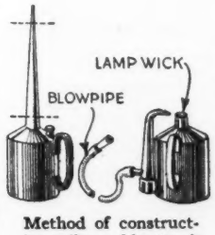
When the jar is ready, cut or saw from an old record or other panel material a circular top ½ in. larger in diameter than the jar. Drill holes for the binding-posts, shaft, and fastening screws.

The top with the condenser fixed to it is now attached to the glass jar with sealing-wax. This may be accomplished by winding a turn of tire tape around the outside of the top, turning the unit upside down, and pouring the heated sealing-wax into the "gutter" between the tape and the jar. The wax may be obtained by breaking up some discarded B batteries. When the wax is cool, remove the tape.

This type of inclosed condenser is dust and moisture proof. It will find favor with transmitters and experimenters who desire to use a liquid dielectric, such as oil. This is impossible with many commercial types, as the condensers have bottoms that are merely bolted on and are not leakproof.—ROBERT P. BROOKS.

Oilcan Makes Serviceable Lamp and Blowtorch

TO MAKE an alcohol lamp and blowtorch for soldering, cut the spout from an oilcan where indicated by the dotted lines in the accompanying illustration so as to leave about ¾ in. of the spout attached to the can. Cut off the tip of the spout and close the lower end with solder. Solder this part to the side of the can and bend the end over sufficiently to allow a jet of air to strike the flame. Drill a small hole in the spout near the bottom and insert the tube previously removed, soldering it in place.



Method of constructing oilcan blowtorch

Then attach a length of rubber tubing and a mouthpiece. The jet from which the air is blown should be reduced to a very small hole. Candle wick is used in the burner.—T. F. DUNFORD, Detroit, Mich.

Sargent Planes are *simple in adjustment, keen and lasting!*

The Sargent Auto-Set Bench Plane is the handiest all-round plane you could have in your workshop. It is true, keen cutting, time-saving. It can be used on the rougher jobs where a good deep cut is a necessity as well as on finer work requiring a clean, quick finish.

You'll find its adjustments remarkably simple. With the auto-set feature you can remove the chromium steel cutter, whet and replace it without changing the original adjustment.

Then there's the Sargent Steel Block Plane. This is small in size and a right convenient tool for any work-bench. The special low angle arrangement of cutter makes it particularly good for cross-grain cutting and rough or knotty surfaces. And you can't beat it for the finishing touches or work in close quarters.

See these planes at your hardware dealer's and write for the Sargent Book of Planes, which is full of detailed information.

SARGENT & COMPANY
50 Water Street *Hardware Manufacturers* New Haven, Conn.

SARGENT
Tools & Hardware

$25.00 in PRIZES See top of page 6 in front of book for details

Big 3-Ft. Telescope Useful and Entertaining (In Five Sections)

See people and objects miles away, on land or sea, as if they were close. Wonder Telescope gives new pleasures to home, farm, camp, travel, sport. See moon and stars as never before. Opens out over 3 feet long; measures 12 inches closed. Brass bound; has powerful lenses. **Thousands pleased**—"Could tell color of aeroplane 4 miles away."—Mrs. Yarbrough. "Saw Provincetown Light, 28 miles away, as clear as if in front of me."—Clyde Scribner.

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SEND NO MONEY

"I have been watching submarines 3 miles off the coast."—P. Grush. "Can see children playing in school yard 6 miles away."—P. H. Hennington. "Read the numbers on freight cars mile away, see mountains on moon."—A. O. Palmer.

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Because of a fortunate purchase from a large European manufacturer we can give you a big bargain. Be first in your neighborhood; entertain your friends. **Send no money;** send only name and address for telescope complete by parcel post. On arrival deposit with Postman only $1.85 plus a few pennies postage. **Satisfaction guaranteed** or money refunded. Order **today** while the supply lasts.

FERRY & CO., 630 Jackson Blvd., Dept. 1785, Chicago, Ill.

ATKINS
SILVER STEEL SAWS

Hack Saw Blades and Frames

ATKINS "Non-Breakable" Blades and Atkins "Easy-Grip" Hack Saw Frames make light work of the hardest metal-cutting job. The blades are specially tempered by an exclusive process, which makes the cutting edge extremely hard and the body unusually tough and flexible. That's why they cut fast, clean and easy, and do not break. Atkins "Easy-Grip" Frames direct full force of the stroke to cutting edge of blade. Nickeled and polished, adjustable 8 to 12 inches; hard rubber handle.

Power Hack Saw Blades

There are Atkins Blades for every metal-cutting machine. "Saws in the Shop" gives the correct blade for each machine and job, and shows how you can get 26% more service with Atkins KWIK-KUT Power Hack Saw Machines.

Atkins "400" Hand Saw

The finest hand saw made. Blade is "Silver Steel" which cuts easier, faster, cleaner and holds its edge longer than any other saw steel. Beautifully finished; made with skew or straight back. Rosewood handle. Perfection pattern. "Saw Sense" gives full details of this splendid saw.

Get These FREE BOOKS

"Saw Sense" shows Atkins wood-cutting saws for home or shop use. "Saws in the Shop" shows our metal-cutting saws. Write for the one you need.

E. C. Atkins & Co., Inc., Dept. D-20
Indianapolis, Ind.

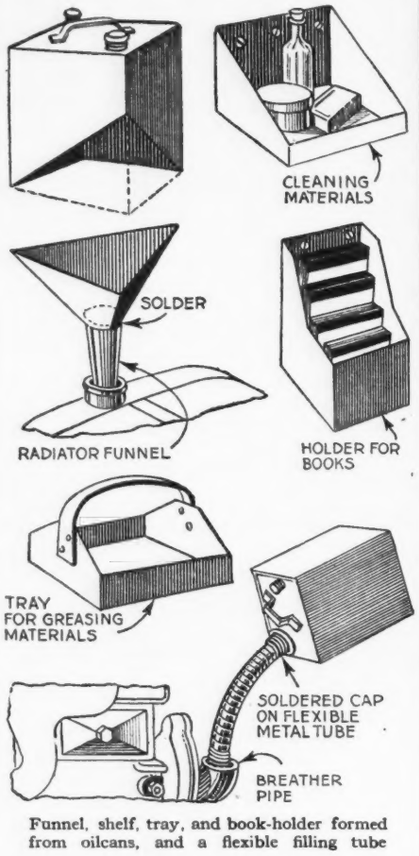
Makers of "Silver Steel" Saws and Tools—Sold by Dealers Everywhere.

Conveniences for the Home Garage Made from Oilcans

EMPTY 1- and 5-gal. oilcans, which usually collect about the garage, can be made into many simple conveniences by the car owner. In utilizing such tins, the main considerations are that all cut edges should be turned over and that the soldering should be heavily applied.

Five features are illustrated and they are so simple that they can be duplicated by any motorist.

A large funnel is made by cutting one corner from a 5-gal. container. The edges are turned over and the corner is cut open



Funnel, shelf, tray, and book-holder formed from oilcans, and a flexible filling tube

to accommodate a 1½-in. tube made from the same sheet metal, which is inserted in the hole and soldered.

For filling an inaccessible reservoir opening, a flexible section of ¾- or 1-in. metal tubing is soldered to the cap of the 1-gal. can.

A shelf for cleaning materials and polishes is made from the bottom of a large can by cutting the edges diagonally, turning them over, and securing the section to the wall behind the bench.

A tray for the greasing equipment requires one long side of a large can with a fabric strap for a handle. With this tray containing oilcans, grease gun, cup grease, spring oil, gear oil, and various tools for the removal of oil and grease plugs, the lubrication of the car is accomplished quickly and easily. Another fixture is a holder for instruction books, clippings, charts, and auto references.

These few suggestions are typical of many conveniences, including drip pans, storage boxes for small tools, and holders for vulcanizing materials.—G. A.

LOFTIS BROS. & CO. Estb'd 1858
DIAMONDS WATCHES
CASH or CREDIT

DIAMOND IMPORTERS
We import Diamonds direct from Europe and sell direct by mail—a great saving to you. Our Diamonds are "quality" gems, blue white, perfect-cut, personally inspected by our expert buyers.

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Over 2,000 illustrations of Diamonds, Jewelry, Watches, Pearls, Mesh Bags, Silverware, etc. Sent prepaid for your Free Examination.

TERMS: All orders delivered on first payment of one-tenth of purchase price; balance in equal amounts within eight months, as suits your convenience.

Satisfaction Guaranteed or Money Refunded

WEDDING RINGS
All Platinum, $25 up. With Diamonds: three Diamonds, $65; five Diamonds, $80; seven Diamonds, $95; nine Diamonds, $110; surrounded by Diamonds, $225. Solid White or Green Gold, $5 up.

NO. 16—Wrist Watch, Solid 18-k White Gold, 17-Jewels, guaranteed, $29.75; 16 Jewels, 14-k, $24.85.

Railroad Watches—Guaranteed to Pass Inspection
HAMILTON NO. 992. 21 Jewels, Adjusted to 5 Positions, Gold filled 25-Year Case - - - $55
ILLINOIS "BUNN SPECIAL." 21 Jewels, Adjusted to 6 Positions. Gold filled 25-Year Case - - - $50
ELGIN'S LATEST RAYMOND. 21 Jewels; 8 Adj. Runs 40 hours one winding. Gold filled 20-Yr. Case $55

LOFTIS BROS. & CO. Estb'd 1858 THE NATIONAL JEWELERS DEPT. N-671 108 N. State St., Chicago, Ill. Stores in Leading Cities

Let Sousa tell You Music Success Secrets FREE

Conn instruments speed your progress—insure success. Used and endorsed by world's great artists. Exclusive features, including the famous hydraulic expansion of tubing, make Conns—easiest to play—beautiful in tone—perfect in scale—reliable in action—slide, valve or key—artistic design and finish.

Free Trial; Easy Payments. Send for your copy of "Success in Music" by Sousa and other famous musicians, and details of trial offer. All exclusive Conn features are yours at no greater cost.

C. G. CONN, Ltd.
532 Conn Bldg. Elkhart, Ind.

CONN BAND INSTRUMENTS
WORLD'S LARGEST MANUFACTURERS

MAN WANTED Handle County BUSINESS.
Experience unnecessary. Largest concern of its kind in the world. *OUR MEN NOW GETTING $200 WEEKLY.* Lowest prices.
RED SEAL COAL CO.
214 Coal Exchange Bldg., Armour Sta., Chicago

SEND FOR THE INTERNATIONAL CATALOG

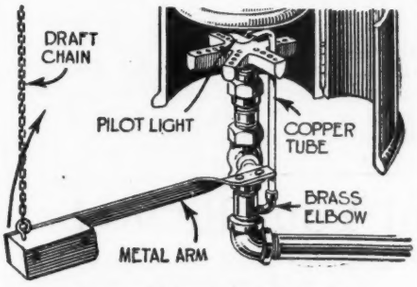
Our net price list. Full line of auto bodies and accessories for Fords at *Wholesale Prices.* Save big money on bodies by buying Direct from Factory.

FOR FORD—Prices from $27.85 up. Factory to consumer direct—Pay only One Profit
International Body Works, 914 W. Ohio St., Dept. 8, Chicago, Ill.

Gas-Heater Control Operated from Floor Above

THE householder who lets his gas bills mount because he is too lazy to run down to the cellar and turn off his gas water-heater promptly, can install semi-automatic control at an expense of half a dollar and 30 minutes' work.

Bore a ¼-in. hole in the gaspipe below the heater valve. Tap it with a 5/16-in. tap, and screw in a brass elbow, obtainable at any hardware store. Swage into the elbow a copper tube long enough to reach up 1 in. above the burner and bend over



Chain pull located upstairs turns on or off gas water-heater in cellar

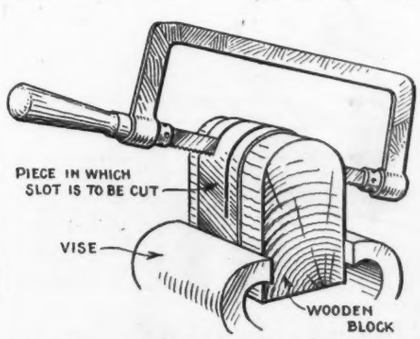
the end horizontally. The tip should be squeezed together to allow only a tiny flow of gas, which, when ignited, serves as a pilot light.

Bolt a metal or hardwood arm about 1 ft. long to the valve handle and provide a heavy counterweight. Run a chain from this to the first floor and fix hooks or other means for fastening the end. If the furnace has an upstairs control, simply disconnect the chain from the draft door and use it, because you need the gas heater more in the summer when the furnace is out.

Varying installations of furnace and heater will require modification of these directions, but there are few homes in which the idea cannot be worked out efficiently.—N. W. HOPKINS, Detroit, Mich.

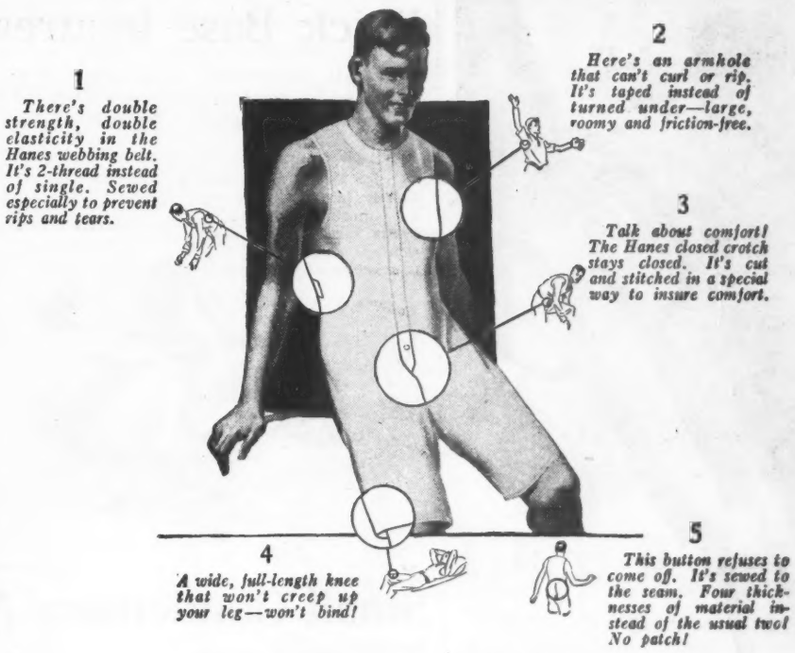
Cutting Slots in Thin Metal

A SLOT in thin metal often can be cut quickly by bending the piece around a wooden form held in a vise, as shown, and using a hacksaw. After the two long



The metal is first bent around a wooden form and cut with a hacksaw

cuts are made, the piece is flattened and the ends of the slot cut with a cold chisel. The edges are then trimmed with a file.—WILLIAM J. EDMONDS, JR., Whitehall, N. Y.


1
There's double strength, double elasticity in the Hanes webbing belt. It's 2-thread instead of single. Sewed especially to prevent rips and tears.
2
Here's an armhole that can't curl or rip. It's taped instead of turned under—large, roomy and friction-free.
3
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5
This button refuses to come off. It's sewed to the seam. Four thicknesses of material instead of the usual two! No patch!

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STICKY DAYS!! But you can come mighty close to comfort even when the cushion of your office chair feels as if it had been held over a blast furnace.

Hanes Athletics were built for your summer comfort. Think of free, easy, loose-fitting legs that never crawl into a bunch. A closed crotch that really stays closed. Think of all the things that have made you underwear-conscious in hot weather. Square them against the famous five Hanes points!!

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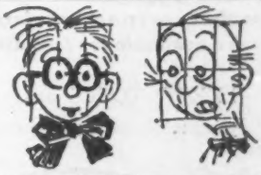

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Brick Base Insures Fine Flower Beds

SMALL ornamental flower-beds prepared by amateur gardeners often fail to develop satisfactorily because of the poverty of the soil. Simply removing the earth from the flower-beds and replacing it with rich dirt is not always sufficient, as the adjacent or under earth quickly impoverishes the new soil.

Closely laid without mortar, the bricks retain the rich soil and store up surplus moisture

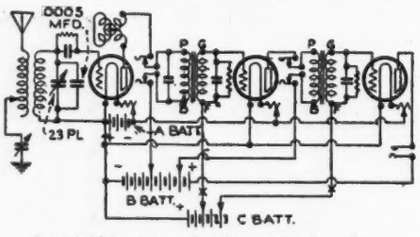
This difficulty has been overcome by gardeners in Washington, D. C., where the flower-beds are universally admired, by the expedient of laying a floor or base of ordinary building bricks and a circular retaining wall of brick, as illustrated. These bricks are not laid in mortar, but are placed as closely together as possible. The circular wall is made of single bricks placed on end.

These brick beds are used in ground that in many instances is mainly clay or gravel. Besides retaining the rich soil, the bricks absorb vast quantities of water, which is given back gradually to the flowers.—G. A. L.

Small Condensers Aid Your Radio Set

THE proper placing of a fixed condenser often will make the difference between good and poor radio reception.

When a one-tube regenerative set is used, there is often no need for a fixed condenser across the phones to by-pass the high-frequency current flowing in the plate circuit around the high resistance to these currents offered by the phone windings. This is due to the fact that the cords of the phones provide the capacity required for the purpose. When one or two stages of audio frequency are used, however, the required capacity is removed as soon as the phones are taken out of the plate circuit of the detector stage. It is advisable in such cases to use a .001 mfd. fixed condenser across the primary of the first transformer.



A typical two-stage hook-up, showing places where fixed condensers often help reception

Those who have been puzzled to know why the first stage does not step up the volume as it should, or find that they have to retune their sets when they plug their phones into the first or second stage after having first tuned in a station on the detector stage, usually will find that this fixed condenser across the transformer's primary winding will eliminate the difficulty.

Noisy operation or howling in the amplifier stages often can be corrected by connecting fixed condensers of from .0005 to .002 mfd. across the secondaries of the amplifying transformers. In some cases connecting grid leaks of from ½ to 5 megohms across the secondaries of the transformers will accomplish the same results. In other cases, connecting a condenser and grid leak in parallel and the combination across the secondary, will give even better results. Different values and combinations should be tried.

Still another stunt is to connect a fixed condenser between the F terminal of the secondary of the transformer and the filament circuit at the points marked *X* in the accompanying illustration, instead of connecting the F terminal direct with the filament circuit or the C battery.

If you find that your 11-plate or 23-plate variable condenser does not give the amount of capacity you require, remember that when two condensers are connected in parallel, the total capacity of the combination is equal to the sum of the two. When you want a capacity smaller than any condenser you have, either fixed or variable, remember that two condensers connected in series give a capacity of less than the smaller of the condensers.

In the illustration a .001-mfd. condenser across the secondary was obtained by connecting a .0005 fixed condenser in parallel with the 23-plate condenser whose maximum capacity was .0005 mfd.

Slip-Cover Keeps Dust from Radio Receiving Set

STANDING idle much of the time, the ordinary radio cabinet and panel constantly are in need of dusting. The polished surfaces seem natural dust collectors. This can be overcome by making a slip cover of imitation leather or cloth similar to one used for a typewriter. Slits may be made for the wires.—DAVID COUTTS.

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EQUAL to the widest range of reception requirements, *Marle Transformers* amplify the weakest broadcasting, over frequencies all the way up to 3500 cycles without variation. Perfect tone quality. Utter absence of howling or distortion. To get the most out of radio—use *Marle Transformers.*

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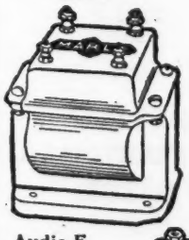

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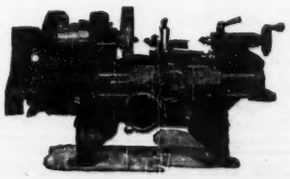

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9-inch Engine Lathe 2½ ft. bed

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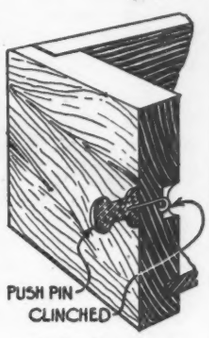
See top of page 6 in front of book for full details

Glass Push Pins Serve as Knobs for Smaller Drawers

WHEN constructing homemade furniture, it is not always easy to obtain suitable knobs for small drawers, yet the knobs must be in harmony with the design of the article or the work will present an amateur appearance. Glass push pins make excellent knobs for such drawers.

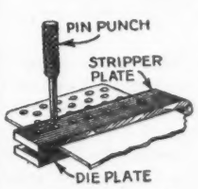
The pins are attached by pushing them into the drawer front. If the front is thin enough, the point of the pin can be clinched over; if it is too thick, bore a hole partly through the back, as indicated, to make a thin place in which the pin can be clinched. Anneal the point in a flame before clinching.—H. P. CLAY, Kingsburg, Calif.



Push pin used as a drawer knob

Punching Holes in Sheet Metal

THE perforated zinc drum of our washing machine broke in several places recently and had to be renewed. This was done by using a sheet of copper, in which 2850 holes were punched by means of the tool illustrated. The same tool could be used for perforating any thin sheet metal.



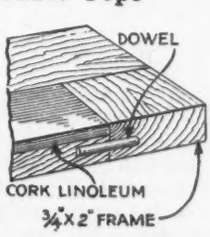
Simple punch and die

The die plate is a length of ¼ by 1½ in. bar iron about 2½ times as long as the width of the sheet to be punched. The bar is heated, folded as indicated, and drilled with holes through both upper and lower arms. The punch is simply a machinist's pin punch of the same size as the hole; it has a long shank and is hardened.

The sheet to be punched is laid out with a scriber and centers are marked with a prick punch, so that they can be seen through the holes in the stripper plate. The wear on the punch is hardly noticeable.—HARRY W. LEUTNER, Baltimore, Md.

Linoleum Table Tops

FOR some purposes a table top covered with cork linoleum has advantages over either wood or porcelain. In one instance I glued a sheet of green cork linoleum over a foundation of ⅝-in. wood and trimmed the edges flush with a sharp plane. A ¾ by 2 in. rim of oak was then made and doweled to the top. Used in place of marble on the top of a washstand, this was found very satisfactory.—A. D. K. DEWET, Newcastle, Natal, S. Africa.



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Your odd-job helper!

THESE are the days when odd jobs pop up and your spare time is profitably filled in doing them.

You'll have to *overhaul your car* and get it ready for summer service. THE PRENTISS VISE will hold the work so you can have "both hands free."

You'll want to fix the screen doors for the fly-weather that's arriving and *build something for the house.* The PRENTISS VISE will serve as a never-failing helper.

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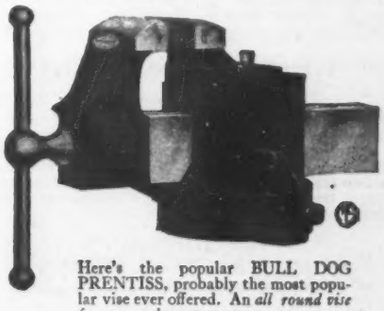

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The two-piece crank set and two-point ball bearings will outlast any other type, and make pedaling easy as walking.

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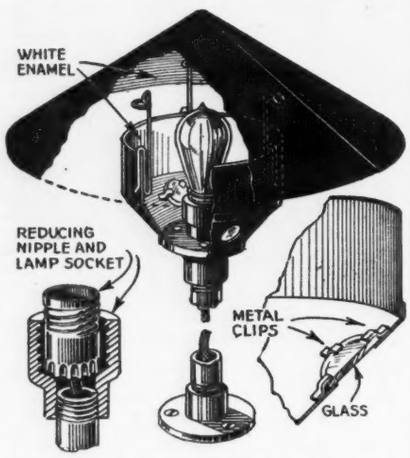
Indirect Illumination at Bench Prevents Eye Strain

FOR the home worker who spends many evening hours at his bench, proper illumination is a detail of considerable importance. Practically all benches are fitted with some form of open or partly shaded droplight, and the direct reflection from the polished surfaces of tools and materials is trying on the eyes.

Indirect lighting, which has given such general satisfaction in other applications, is simply installed above the workbench because it is not necessary to provide an elaborate or ornamental fixture. The fixture shown can, indeed, be made up from simple materials and tools in an hour or two of spare time.



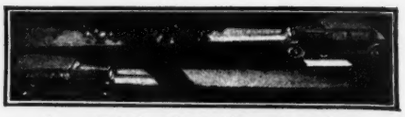
Improved bench lamp stand and shade made mainly of pipe fittings and sheet metal

The base is a pipe flange; the support for the light screws into this and connects with a second flange above. A bowl-shaped holder is riveted to the upper flange and serves to shroud the light. In this bowl, several large holes are made and circular sections of frosted glass are secured behind them with small metal clips. A lamp socket is screwed either directly to the top of the pipe forming the support or into a reducing nipple fastened to it.

The main reflector is a flat, cone-shaped cover, with three wire legs that wedge tightly into the bowl. Being detachable, it allows the easy removal of the lamp bulb. Both bowl and reflector can be made of sheet tin; the supports and fittings are ordinary wrought-iron pipe. The inside of the bowl and reflector should be painted with white enamel, preferably baked on.—G. A.

Repairing a Garden Hose

A LEAKY or peeled spot in a lawn hose may be repaired by coating it with one of the tarry preparations applied to paper roofs. The hose should be thoroughly dry so that it will absorb the heated pitch readily. After the first application has dried, which will be in less than a minute, add more, spreading it with a pliable stick, until five or six coats have thoroughly sealed the porous spot. Tape should then be wrapped around the spot to protect the hands and keep the roof paint from chipping off.—JOHN L. DOUGHENY, Toledo, Ohio.



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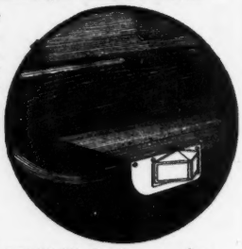
AUTO-PAS for *Safety*

No other light possesses the wide range of night driving securities provided by

AUTO-PAS safety light

(Made in California)

No other light so quickly and dominantly gets the right of way, for its three-way light rays are always recognized and obeyed. Installed on the left running board, the green light of *Auto-Pas* prevents side-swiping and collision, while the red light behind and the white light on the road, shows exact safety clearance to passing cars.



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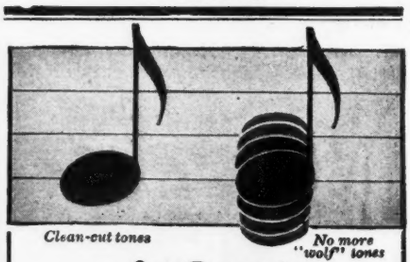

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Now you can easily have the place in the band you've longed for! In *30 days* you can be playing! For the world's foremost music house now offers you instruments with *continuous conical bore*—a *revolutionary* improvement.

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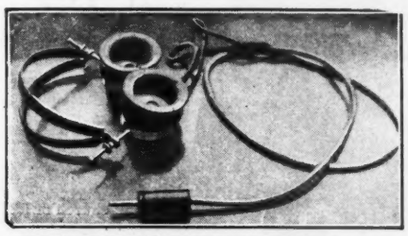
Flexible Tube Keeps Phone Cords from Kinking

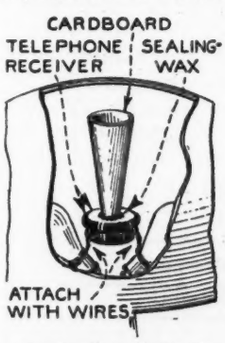
ALMOST every radio fan is annoyed more or less with tangling and kinking telephone cords. I found a simple solution for this problem by pulling the telephone cord through a section of flexible metal tubing, such as is used for small gas-stove connections. Rubber tubing probably would have done as well. The same device is equally useful for preventing the electric iron cord from becoming tangled.—HARRY SCHULTZ, Astoria, N. Y.



Rubber or flexible metal tubing slipped over telephone cords prevents wires' tangling

Library Lamp Loudspeaker

A TABLE lamp with a large dome-shaped glass shade makes an excellent radio loudspeaker. Attach a cardboard "horn" to a loudspeaker phone unit with glue or sealing wax. Fix this in the shade as indicated so that the mouth of the horn is about 2 in. away from the top. The length of the horn is determined, therefore, by the space available in the dome above the lamps. It need not be very long, as the dome will do the greater part of the tone amplification.



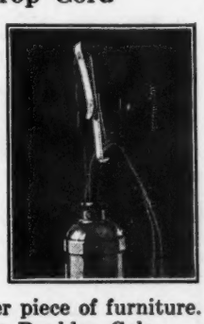
Loudspeaker fastened under a glass dome

The horn should not taper too much and the smaller end should not be larger than the hole or holes in the earpiece of the phone. Experiment by moving the horn up and down until it is located so that the sound waves spread over the expanding surface of the shade.

One advantage of this loudspeaker is that it distributes the sound all over the room. It reproduces speech, music, and code without distortion.—D. MCINTYRE.

Ring Clip Adjusts Length of Electric Drop Cord

AN ORDINARY key-ring belt clip is useful for adjusting the length of an electric drop-cord. It holds the cord firmly and provides an easy method of hooking it over a nail or, if the clip is sprung out, over some part of a bedstead or other piece of furniture. —HAROLD E. BENSON, Boulder, Colo.



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The type A.B.-FF charger performs three duties economically. Charges radio 2, 4 or 6 volt "A" battery, radio "B" battery up to 120 volts and auto batteries. Average cost per charge about a nickel. Solidly built—will not get out of order. Fool-proof and simple. The first successful charger—introduced over ten years ago.

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Write for literature including station calls, hints on battery upkeep and wiring diagrams for basement installation of batteries. We'll furnish you name of dealer who will supply you the genuine FF charger.

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10418 Berea Rd., Cleveland, Ohio

Home Workshop Chemistry

Simple Formulas that Will Save Time and Money

NO HOME should be without fire-extinguishers handily located for instant use. When a fire starts—and nowadays there are many fire hazards in even the best administered home—everything depends upon the speed with which the blaze is attacked. It is all very well to count on the fire department's turning out within a few minutes. One or two minutes at the start often makes all the difference between a trifling and a disastrous fire.

Fortunately it costs little in time or money to provide fire-extinguishers and racks to hold them. They should be placed at points of danger—beside the

If used quickly enough, homemade fire-extinguishers will put out almost any fire

furnace in the cellar, in the kitchen, alongside the home workshop bench, and near stairway landings.

Fire-extinguishers, both liquid and solid, simply smother the flames by preventing the air from reaching them. The flames from both burning liquids and solids are due to ignited gases, and these gases require oxygen to support combustion. As soon as the fire is deprived of its oxygen, which is taken from the air, it goes out.

For this reason it is only necessary to add to an incipient fire certain types of chemicals that will remove all available oxygen from its immediate vicinity. A number of these are known and some are quite important. The most universally employed is the liquid carbon tetrachlorid (a well-known cleaning fluid is practically the same thing). The liquid usually is sprayed on the fire with small hand pumps.

Another method of using carbon tetrachlorid as a fire-extinguisher is in bombs. These are most conveniently prepared from burnt-out electric-light bulbs. Fill a dish—which should not be too shallow—with carbon tetrachlorid. Then take one of the old bulbs and a pair of pliers, dip the tip of the bulb into the liquid, and carefully break off as small a piece of the tip as possible.

Since these bulbs are highly evacuated, the pressure of the air will force the liquid

(*Continued on page 119*)

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Unequaled in beauty of tone; the favorite instrument in band or orchestra or for home, school, church or lodge entertainment.

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In one hour you can play the scale—in a few weeks play popular tunes and in 90 days take your place in band or orchestra. You may order any Buescher Saxophone, Cornet, Trumpet, Trombone, etc., without paying in advance and try it six days in your own home. If satisfied, you can pay for it on any of our terms to suit your convenience.

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Here is real foot comfort for everybody! A resilient soft, sponge rubber and wool felt Arch Support that fits in any shoe and makes walking a joy. Weighs less than one ounce, yet is strong enough to support the heaviest man or woman. Throw away your old stiff leather and steel supports and try something that will really bring you ease and comfort and build and strengthen your ankles at the same time. Endorsed and used by Chicago Cubs and other prominent athletes. Price, $2.00 a pair, either cash with order or parcel post C. O. D., as you prefer. Order today and bring real ease and comfort to your feet. Be sure to specify shoe size.

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THIS great boxing course—six big books containing 381 pages and 250 photographic illustrations—teaches you **in your own home** the secrets of ring science, and the blows and guards of the world's greatest boxers—Jack Dempsey, Benny Leonard, Mike Donovan, Bob Fitzsimmons, Kid McCoy. **All for $1.67. And you can have it on 10-day trial. Send no money.**

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Jiu-Jitsu and Wrestling is also included—how to disarm an opponent, how to throw him if he grabs you from behind, how to break a strangle hold, the Gotch Toe Hold, the Stecher Scissors Hold, the Head-lock, etc.

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Jos. De Roy & Sons, 4720 De Roy Bldg. Only Opposite Post Office Pittsburgh, Pa.

Home Workshop Chemistry

(*Continued from page 118*)

into the bulb. In other words, the fluid is sucked up until the bulb practically is filled. Lift it out of the dish and place it, tip up, in a holder or rack. It is best to seal the tip with sealing-wax or wax, but take care that the fluid does not come in contact with and dissolve the wax.

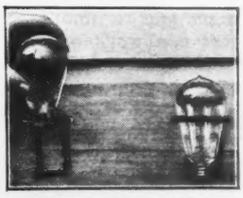
Hang a rack containing several of these bombs in one or more safe and easily accessible spots. If a fire starts, hurl bombs at the worst part of it with sufficient force to break the glass.

Carbon tetrachlorid is perhaps the best type of extinguisher for fires of electrical origin where chemicals that conduct the electrical current would make the fire worse and might be fatal to the user. It produces a gas heavier than air, which blankets the fire when the fire is near the ground or some level spot, even such severe fires as those produced by gasoline, alcohol, and turpentine.

Filling an old electric lamp with carbon tetrachlorid

Liquid-filled hand grenades—that is, old electric-light bulbs filled as described, but using water in which such chemicals as sal ammoniac, borax, calcium chlorid, Epsom salts, and the like are dissolved, also are in common use, but these are of value only when the fire is still in its first stages and has not spread too far. A solution of 20 oz. of calcium chlorid and 5 oz. of table salt in a little more than ½ gal. of water, is quite effective.

Homemade powdered fire-extinguishers are not of so much value to the householder, although they do perform excellent service in the laboratory where a fire usually is local and no more than 1 or 2 ft. in diameter when in its first stages. Of all powders, sand is the best to use on a chemical fire, but a mixture of equal parts of common table salt, sal ammoniac, and bicarbonate of soda in 2-qt. wide-mouthed jars, is also good if a large box of sand is not available in the laboratory.



One easily made type of bomb rack

A few years ago, while making benzyl-benzoate, the flask containing metallic sodium dissolved in benzyl alcohol broke into spontaneous combustion while pouring this hot mixture into benzaldehyde. The flask broke, scattering the flaming chemicals all over the laboratory floor. Sand and dirt were thrown on the fire, which flickered, smoked, and was out. The floor later was found to be covered by less than ¼ in. of sand, but this had saved the laboratory.

Why Good Machines Have High Aims

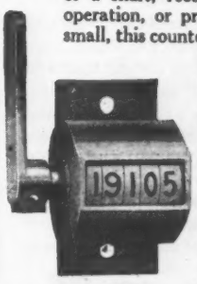
Count the production, aim at an increase—and you manage to get the increase!

"Easy going" or under-developed machines need a production-goal. The goal may be set and the standard *met*, with the aid of a Veeder Counter.

You don't know what your machine can *DO*, without watching its record on a counter. You don't know when it's mechanically right or rightly *run*—without the result-record on a

Veeder COUNTER

The small Revolution Counter below registers one for a revolution of a shaft, recording a machine operation, or product. Though small, this counter is very durable; its mechanism will stand a very high rate of speed, making it especially suitable for light, fast-running machines and most adaptable to experimental work. If run backward the counter subtracts. Price $2.00. (*Cut 4-5 size.*) Small Rotary Ratchet Counter, to register reciprocating movements of small machines, also $2.00.



The Revolution Set-Back Counter below records the output of the larger machines where a shaft-revolution indicates an operation.

Sets back to zero from any figure by turning knob once around. Supplied with from four to ten figure-wheels, as required. Price with four figure-wheels as illustrated, $10.00—subject to discount. *Cut less than one-half size.* Set-Back Rotary Ratchet Counter, to record reciprocating movements as on punch presses, $11.50 (list).

These counters and others for every possible need are shown in the Veeder booklet—an 80-page free guide.

The Veeder Mfg. Co.,
44 Sargeant St., Hartford, Conn.

It's So Simple—
Your Boy Can Do It

It's fun to repair punctures—if you use a Shaler. It's the easiest and best way, too, because Shaler "Hot Patches" are *heat-vulcanized* to the tube so that they can't loosen or come off. It's so simple that your boy can do it.

To make a permanent repair merely clamp a Shaler Patch-&-Heat Unit over the puncture, cut or tear and light the solid fuel it contains. Exactly enought heat is generated to vulcanize the rubber. After five minutes take off the pan and throw it away. That's all. The tube is ready to use. Anyone can do it anywhere. No gasoline, no cement —no danger of burning the tubes.

SHALER
5-Minute Vulcanizer

Millions of motorists carry the convenient Shaler Vulcanizer in their cars. They like to tell their friends about it and they can hardly understand why anyone nowadays should ever want to bother with "sticking on" cold patches that soon loosen and come off. It's so much easier to "vulcanize *First* and make it *Last.*"

Costs only $1.50

Complete outfit includes nickel plated vulcanizer and 12 Patch-&-Heat Units—in a small package, ready for instant use. Wherever auto accessories are sold you can buy the Shaler. Get one for your car today.

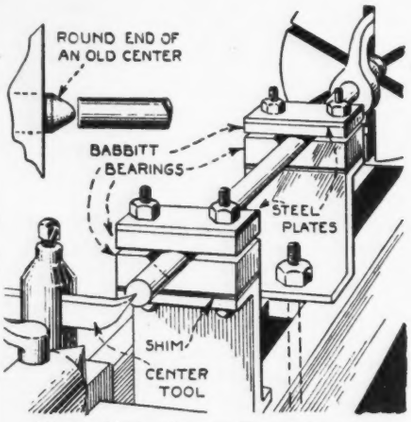
C. A. SHALER CO.
2101 Fourth St., Waupun, Wis.

Centering Small Lathe Work Exactly

By Howard Greene

A SMALL shaft that is perfectly plain and of the same diameter throughout most of its length is often needed in mechanical work. It may, perhaps, have a shoulder at one or both ends, or a reduced part somewhere, but the plain part of the shaft must be accurately concentric with the reduced parts to insure true running. Usually this means that the whole shaft has to be worked down in the lathe from a piece of comparatively heavy stock. If the shaft is long and light, this is likely to be difficult because of the tendency to spring, to say nothing of the time and trouble involved.

To center a small shaft with sufficient accuracy so that the reductions can be made and the rest of the shaft used without turning, is extremely difficult if the ordinary methods of centering are employed. By the use of the simple attachment described, however, centering can be done with such accuracy that it is necessary only to select a piece of shafting or drill-rod of the requisite size for the body of the shaft, center it in the attachment, and then turn the shoulders or whatever is necessary. The result will be a shaft at least as good as if turned all over, and probably better, especially if the shaft is light and springy.



Mounted in two bearing-like attachments, the shaft can be centered accurately

The idea is to center the shaft while it is revolving in bearings, and to mount it so that the lathe tool can work on the end. Make two brackets of cold-rolled steel; the dimensions depending upon the dimensions of the lathe you use. To the under side of each foot rivet a brass block that will fit snugly between the shears of the lathe, and fit a holding-down bolt in any way that the construction of the lathe will permit.

THE two larger blocks at the top of the bracket are of Babbitt metal, the lower one being notched at 45 degrees, and the upper one plain. Two machine screws pass through clearing holes in the bracket. are tapped into the lower block, and run through clearing holes in the upper block. Above is a steel plate, against which the nuts hold, as shown.

By this arrangement the lower block can be adjusted to any height within the range of motion of the screws by turning the screws with a screwdriver, slipping packing strips under the block, and tightening the screws. The cap is tightened upon the shaft by means of the nuts.

The right-angle notch in the lower block is made of such depth that the smallest shafting to be handled will project slightly above the face of the block when in position in the notch. Shafting of much larger diameter can then be handled simply by raising the cap.

TO USE the attachment, set the brackets on the lathe bed, and with the shaft in position, pack up until the shaft is fairly well centered—that is, until it is at the height of the lathe centers; it does not have to be exact. Let the headstock end of the shaft rest against the rounded end of an old center. Put a dog or driver on it so it will be driven from the faceplate in the usual way. Tighten down the nuts until the shaft will turn just a trifle stiffly in the blocks, and put on plenty of oil. Then, with the tailstock pushed out of the way, the slide-rest can be brought up and the end faced off and a center formed with light cuts of a sharp, thin-nosed tool.

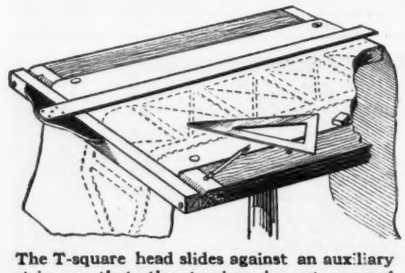
When one end is faced and centered, turn the shaft end for end and treat the other end the same way. The shaft can then be placed between centers in the ordinary way and the turning proceeded with, and it will be found to run true to a hair.

The facing should not be attempted with a tool that has any tendency to dig in. Even for steel it will be best to use a brass-turning tool. If the tool digs in, it will draw the shaft away from its support against the headstock center and make trouble. With reasonable care, however, the method works very well indeed.

Drawing Board Attachment Saves Tracings from Being Creased

FOR making tracings longer than the drawing board, the attachment illustrated is most useful. It prevents tracings from being cracked at the right edge of the board by the T-square.

The right edge of the board is rounded and a strip of wood 1 in. square and as long as the board is wide is fastened to it by means of wood screws and two small spacer blocks about 1/16 in. thick and 5/8 in. square. For greater accuracy and permanency, a steel strip may be used.—J. G. FORREST, South Orange, N. J.



The T-square head slides against an auxiliary strip so that the tracing is not creased

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This year you can make your vacation far more enjoyable than last year. Carry one of these small portable radio instruments wherever you go.

Take it with you camping, fishing or hunting, and best of all, when you get back, set it up in your home. You'll enjoy the OZARKA all year 'round.

Away back from civilization you can still have at your command, the baseball scores and music from hundreds of radio broadcasting stations. Think of being in camp and yet be able to listen to all the wonderful things being broadcasted.

Just turn a dial or two and pick out what is the most interesting to you.

OZARKA
Portable Radio

is a compact three tube instrument, the case is 16 inches long, 10 inches wide and 5 inches high and weighs 10 pounds. In this small space you have a wonderful little instrument and yet built to receive long distances, very often from 1000 miles.

No matter where you go you will always be in touch with the best of radio broadcasting and the OZARKA is so simple a child can operate it. The OZARKA PORTABLE is completely equipped with aerial, "A" and "B" batteries, three No. 199 tubes and one set of head phones, all in one case. Nothing more to buy—all ready to tune in the concerts. PRICE COMPLETE $65.00. Extra phones, per pair, $5.50.

Local Representatives WANTED!

Over 1800 OZARKA agencies have already been established. If you would be interested in the fastest selling article on the market today write for full particulars. Be sure and give the name of your county.

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Special 5 Size Tap and Die Set, Only $3.00
DIRECT FROM THE FACTORY TO YOU!

Our No. 12 Automobile Set furnished in our highly finished chestnut box contains 5 each taps and dies (1-4, 5-16, 3-8, 7-16, and 1-2"), in the S. A. E. thread, 1 die stock, and one tap and reamer wrench.

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Send us your order at once and be one of our many satisfied customers

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Adjusted to the second—temperature—isochronism—positions. 25 year Gold Strata Case, in 100 designs. $1 down. Balance in small monthly payments.
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Dept. 13-65 Chicago, Illinois

How to Build Trellis-Work

(*Continued from page 81*)

7 by 15 in. The drapery is cut from 2 pieces 1⅛ by 8 in. by 2 ft. 2 in.

The 4 brackets are 1¾ by 8 by 14 in. They should be laid out "one in the other" so as to cut without waste. The bracket caps are 1⅛ by 3 by 7 in. For filling pieces under the bottom rail it will be necessary to use 2 sticks ⅞ by ⅞ in. by 2 ft. 8 in. Finishing nails 1½ and 2 in. long are used throughout.

The screen shown (Fig. 2) is a much more substantial trellis and includes a seat and a garden gate. The trellis work on each side of the gate usually is made alike, but two designs are given so as to allow ample choice on the part of the builder.

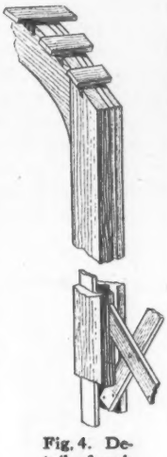

Fig. 4. Detail of arch and light slats

THE post at the extreme left requires 2 stiles ⅞ by 3½ in. by 8 ft. 3 in. Between these stiles is nailed a filling piece 1⅛ by 2 in. by 8 ft. 3 in. The stile that forms the left-hand gate-post requires 2 pieces ⅞ by 5 in. by 8 ft. 7 in., with a filling piece 1⅛ by 3½ in. by 8 ft. 10 in. The vertical muntins are 1⅛ by 2¾ by 5 ft. 11 in. and are halved out to suit the rails, which are 1⅛ by 2¾ by 3 ft. 5¼ in. (Fig. 5). The curved upper rail is made of 2 pieces cut from stock ⅞ by 11 in. by 3 ft. 6 in. with a filling piece cut from stock 1⅛ by 9½ in. by 3 ft. 6 in. The various other filling pieces required can be cut to suit.

The arch is cut from 3 pieces 15/16 by 17 in. by 2 ft. 8 in., and the 8 arch slats are ⅞ by 3 by 12 in. The seat (Fig. 5), if used, is 1⅛ by 16 in. by 3 ft. 10 in., the seat rails ⅞ by 2 in. by 3 ft. 5 in. and the brackets are cut from stock 1⅛ by 15 by 15 in.

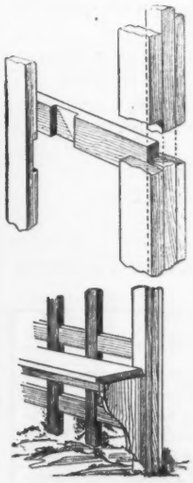

Fig. 5. Construction of the seat and heavy trellis-work

The design at the right of the gate (lower view, Fig. 2) makes use of a trellis-work of ½ by 2 in. slats, and therefore the construction of the posts is modified to suit, as in Fig. 4. Each gate-post is made up of 1 stile 1⅜ by 5 in. by 8 ft. 7 in., 1 stile ⅞ by 5 in. by 8 ft. 7 in., and a filling piece ½ by 4 in. by 8 ft. 7 in. Each outside stile, such as at the right, in Fig. 2, requires 1 piece 1⅜ by 4 in. by 5 ft. 8 in., 1 piece ⅞ by 4 in. by 5 ft. 8 in. and a filling piece ½ by 3 in. by 5 ft. 9 in. The bottom rail requires 1 piece 1⅜

(*Continued on page 122*)

Magnetos come apart quickly

—when you use "Yankee" Ratchet Screw-drivers on them. Every motor mechanic, or car-owner who does his own repairing, knows how long it takes to overhaul a magneto.

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save time by quickly driving and drawing the many small, wobbly magneto screws. The knurled washer on No. 15 particularly is handy for it enables you to start small screws with thumb and forefinger.

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How to Build Trellis-Work

(*Continued from page 121*)

by 3½ in. by 3 ft. 7 in., 1 piece ⅞ by 3½ by 3 ft. 7 in. and a filling piece ½ by 2½ in. by 3 ft. 9 in. The top rail requires 1 piece 1⅜ by 10 in. by 4 ft. 2½ in., 1 piece ⅞ by 10 in. by 4 ft. 2½ in., and a filling piece ½ by 9 in. by 4 ft. The cap is ⅞ by 5 in. square. The details of the gate itself are sufficiently indicated in the drawing.

The fan trellis shown in Fig. 3 requires 15 pieces ½ or ¾ in. thick, 1¾ in. wide and 9 ft. long. These are bolted together at the bottom with 3 long ⅝-in. bolts. The entire bundle, held securely together, is then bored with ¾-in. holes to take the six round cross pieces, which are ⅝ in. in diameter and 14 ft. long. These are soaked in water for at least 24 hours and then slipped through the holes. It is then possible to bend the strips fanlike, as shown, and to drive a ⅞- or 1-in. finishing nail into each intersection. Four anchor pieces ⅞ by 6 in. by 2 ft. 6 in. are nailed to the bottom edges of the vertical members and buried 8 in. deep in the ground.

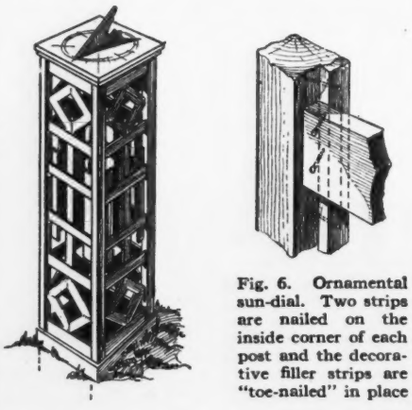

Fig. 6. Ornamental sun-dial. Two strips are nailed on the inside corner of each post and the decorative filler strips are "toe-nailed" in place

THE sun-dial (Fig. 6) is not hard to build when once the construction is understood. Each post, which is 1⅜ by 1⅜ in. by 4 ft. 8 in., has nailed to its inside corners 2 strips ½ by ⅜ in. by 4 ft. and to these strips are nailed the ornamental trellis-work. For a distance of 8 in. the posts are buried in the ground or set in concrete. The sun-dial can be either a homemade one of wood or metal, marked out by experiment to show the time of day, or a purchased dial.

The completed trellises usually are painted, but they may be stained or even allowed to weather naturally, if preferred.

Trellis Blueprint No. 34

FULL working details and complete bills of material for trellises, such as described in the foregoing article, are contained on Blueprint No. 34 of the Home Workshop series. This may be obtained for the nominal price of 25 cents to cover the cost of blueprinting, handling, and mailing, from POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York.

Among articles scheduled for early publication in the Home Workshop Department are "Valuable 'Antique' Chair Made with Ordinary Hand Tools," "Playing Water Polo on Aquatic Ponies," "Constructing a Rustic Summer House," etc.

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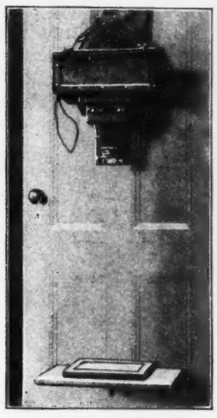
Enlarging Outfit Is Mounted on Door to Save Space

LACK of room prevents many amateur photographers from enlarging their negatives. How the writer overcame this problem may help others in the same predicament.

After the enlarging camera was built it was suspended on the back of the door of an attic room on two hooks screwed into the door, but not far enough to go through on the other side. The enlarging board, also suspended from hooks, can be placed at various distances from the lens so that prints of different sizes can be produced.



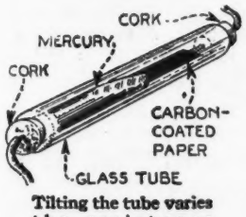
The enlarging outfit in use

After use the enlarging board and camera are unhooked and set away.—GEORGE BENDER, Jersey City, N. J.

Mercury Is Used in Making Unique Adjustable Grid Leak

OFTEN the radio fan who likes to make his own apparatus is puzzled when it comes to preparing an accurate and delicate grid leak. This is really a simple matter, however, and a grid leak can be made that will give precisely the critical adjustment so necessary in many modern circuits.

The container is simply a glass tube with two corks. Prepare a small strip of Bristol board to fit inside the tube and give it two coats of ordinary India drawing ink. Wind a piece of bare copper wire around the end of the strip and slip it through the heat in one of the corks.



Tilting the tube varies the resistance

Another piece of wire is pushed through the hole in the other cork so that it projects a trifle inside the tube and a few drops of mercury are placed inside the tube. Then, when the leak is tipped, the mercury covers or uncovers the carbon-coated paper and consequently alters the resistance.

The tube can be placed on the end of a brass rod and turned by means of a knob from the front of the panel. Use flexible leads for the connections.—CARTER FISKE.

ANY one who has tried to cut sheet celluloid knows it is not as easy as it looks. The best way is to make a deep scratch with a sharp scriber or the like, and then part the celluloid by bending it sharply along the scratch. This trick is useful, particularly when curved or irregular shapes have to be cut.

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An automobile goes 27 miles on air by using an automatic device which was installed in less than 5 minutes. The automobile was only making 30 miles on a gallon of gasoline but after this remarkable invention was installed, it made better than 57. The inventor, Mr. J. A. Stransky, 625 Eleventh Street, Pukwana, South Dakota, wants agents and is willing to send a sample at his own risk. Write him today.—Adv.

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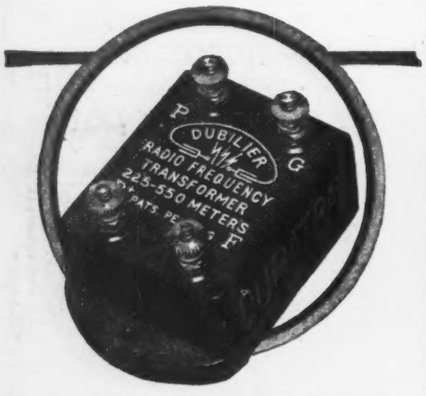

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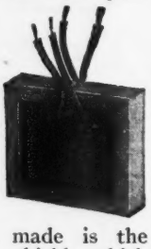
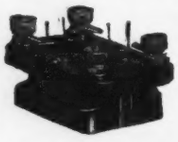
The correct design of the Kellogg transformer is a result of exhaustive study of sound waves and of the audio-frequency currents representing them, and has eliminated to the last degree of distortion of overtones which gives the tone-quality to the wave being amplified. Our 25 years of experience building transformers has developed a one piece silicon steel, laminated core; note the absence of punched holes, which so frequently cause loss of power. Not less carefully made is the brass shield, which makes close mounting possible without interference.





Note also how the ends of the windings are brought out and soldered in plain sight to the terminal posts; there are no concealed soldered joints.

Terminals plainly marked for connecting.

If your dealer or jobber does not handle Kellogg equipment, write us mentioning his name.

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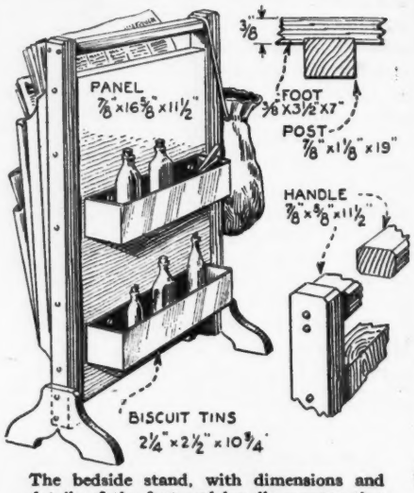
Neat Bedside Stand Requires Less Space than Table

BY LONG test the bedside stand illustrated has proved itself to be more serviceable both in illness and for daily use than the ordinary small bedside table. It provides places for needed articles, has pockets for papers and magazines, and one or more bags can be hung on the posts. A handle allows it to be lifted around readily.

The stock should be hard wood. If a board 16⅝ in. wide is not obtainable, glue



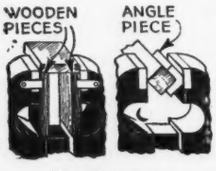
The bedside stand, with dimensions and details of the foot and handle construction

up the main panel in two pieces. Cut this and the handle square and true and exactly the same length, then nail the parts together, being careful not to split the panel. Drill small holes first if the wood is very hard. Cut the feet as shown and notch or dado them to fit the battens and nail or screw them on.

Biscuit tins, of the kind commonly used for crackers of good quality, serve as the small trays shown. A screw at each end holds them in place. It is well to paint or enamel the tins before fastening them on.—A. E. E.

Holding Awkward Work in a Machinist's Vise

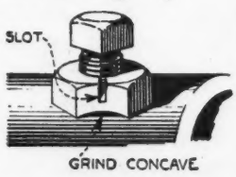
TWO thin pieces of wood placed in a machinist's vise, as shown at the left-hand of the accompanying illustration, will form a rest for flat work that otherwise would be awkward to hold. If much flat work is to be handled, it is well to screw brass lugs to the ends of the vise jaws to keep the wooden supports in place, or they can be bound on temporarily with wire.



Two time-saving vise kinks

Rectangular work that has to be held by the corners can be handled by using a support made from a short piece of flat iron bent at a right angle, as shown in the right-hand view. The sharp outside corner of the angle iron should be filed off. If the work is delicate, a similar piece may be used at the other side to protect the opposite edge.—CAPT. E. A. MCCANN.

Grip Nut with Concave Face Locks Setscrew Tightly



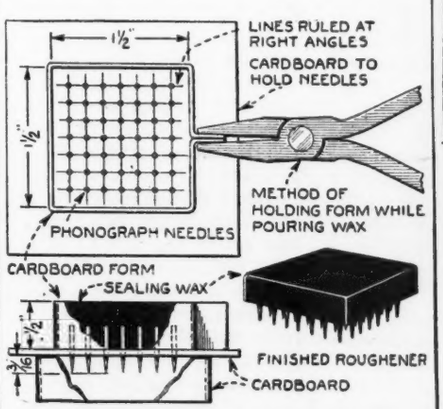
SETSCREWS in pulleys, gears, and similar shaft-driven parts that have a marked tendency to work loose, can be locked tightly with a small nut modified as shown.

The nut is held against a grinding wheel and the bearing face is ground a trifle to make the center concave. The upper side is then slotted as indicated. When the nut is tightened, the pressure on the face causes it to close at the slot, clamping the setscrew rigidly.—G. A.

Phonograph Needle Tool Will Remove Bloom from Rubber

AN EFFICIENT roughening tool to be used when vulcanizing inner tubes or rubber articles, can be made from phonograph needles held in sealing-wax.

Rule on a piece of cardboard a series of seven lines that cross each other at right angles about 3/16 in. apart. At each

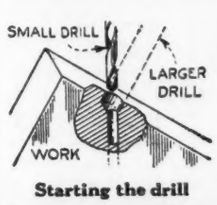


After being driven partly through a cardboard form, the needles are held with wax

intersection a needle is pushed through the cardboard, projecting about 3/16 in. on the other side. A cardboard form then is held above this, as shown in the illustration, and filled with sealing-wax. When cold, the cardboard can be trimmed or soaked off and the sealing-wax will hold the needles firmly in place. This is far superior to the perforated tin tool usually used.—FRANCIS G. LE MERLE, Washington, D. C.

Drilling at an Angle

IT IS next to impossible at times to start a drill at an angle in metal. This difficulty sometimes can be overcome by first drilling a shallow hole straight into the piece with a larger drill and using the conical surface formed by the drill lip angle as a place to start the smaller drill, as illustrated.—H. S. TRECARTIN.



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Money back any time within ten days if dissatisfied. We further guarantee to the publication carrying this advertisement that each and every speaker sold will be exactly as advertised in this issue.

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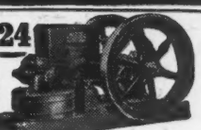
Only $14.24 Down For **2 H-P. WITTE** (*Throttling Governor*)



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The Shipshape Home

Doors that Bind

NOT always is it necessary, as some people suppose, to dress the edge of a door or casement window that binds. Other methods of freeing it are possible, and the use of the plane should be resorted to only when those expedients have failed.

Sometimes, because of too deep setting of the hinges, additional coats of paint, or the swelling of the stile, a door becomes hinge bound. The hinge clearance is too small so that the hinge stile strikes the jamb before the lock bolt engages. This strains the hinges and causes trouble.

The remedy is to remove the screws from the jamb side of the hinges, one hinge at a time, and place a thickness of cardboard behind the hinge. The same effect is often more easily obtainable simply by loosening the screws and slipping a narrow strip of cardboard between the hinge and jamb but in front of the screws, as illustrated in Fig. 1 and shown in the upper right-hand detail of Fig. 5. In the latter case, the hinge pin is thrown forward, as Fig. 5 indicates, and clearance is given to the door.

Fig. 1. Inserting shim from front

Fig. 2. Planing stile above the lock

Fig. 3. Placing cardboard strip behind hinge

Swelling of the door or settling of the building may cause the door to strike on the front edge. If there is more than 1/16 in. clearance on the hinge edge, reverse the treatment described above; that is, slip a cardboard strip between the hinge and jamb, but behind the screws, as in Fig. 3 and the lower right-hand detail of Fig. 5. By thus reducing the hinge clearance, the lock edge of the door often may be made to clear the jamb sufficiently.

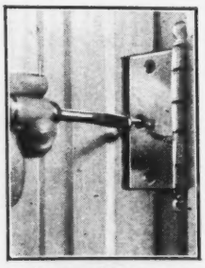


Fig. 4. Setting the lower hinge forward

If the door strikes or binds above the lock, an inspection of the hinge clearance may show that the upper hinge screws have loosened, allowing the door to sag. The remedy is to tighten them again, or, if the holes are worn, to drive wooden pegs covered with glue into them and replace the screws. If the hinge is firm, try reducing its clearance, as in Figs. 3 and 5. Manipulation of the lower hinge is equally effective when the door binds below the lock.

All of these adjustments can be made without removing the pins from the hinges or taking down the door. If they fail to remedy the trouble, planing must be resorted to.

When dressing the upper end of the hinge stile, round the edges slightly to prevent splintering, and push the plane toward the hinge. To dress the stile above the lock, use the plane as in Fig. 2. If the door must be dressed for its full length, remove the hinges, as that is easier than taking off the lock, and the bare wood on the back edge is less noticeable than on the front. The chiseled recesses for the hinges must then be deepened as much as necessary to allow the hinges to set flush as before.

When unevenness of the floor causes the bottom of the door to rub, the door may be cut off sufficiently to clear, but a better way is to set the bottom hinge forward 1/4 in., as in Fig. 4 and the left-hand detail of Fig. 5. Another method is to replace the hinge with a wider one so that the pin of the lower hinge will be farther

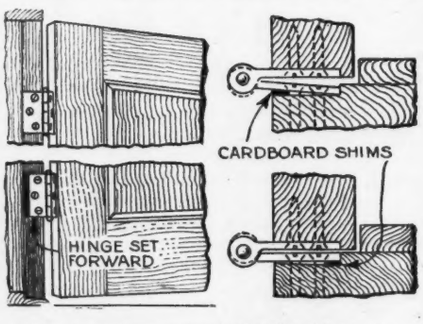


Fig. 5. Three ways of adjusting hinges to prevent doors from binding at bottom or sides

The Shipshape Home

(*Continued from page 126*)

in front of the door than that of the upper. Figure 5 illustrates the principle of this adjustment.

Reseating Porch Chairs

A RUSH - BOTTOM porch chair need not be discarded simply because the bottom is broken. A very good substitute may be made of webbing, which can be bought at any harness shop and comes in several widths and various shades.

The chair illustrated, which was reseated with dull blue webbing 1¾ in. wide, has been in use for two summers and has proved completely satisfactory.

Porch chair reseated with blue webbing

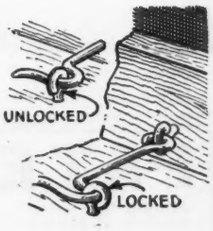
The webbing should be passed around and around from back to front and drawn as tightly as possible until the space is filled.

Tack each strand securely on the under side of the chair at both front and back before pulling the next strand. When the space is filled, cut the webbing and secure the end on the under side. Then weave, basket fashion, from side to side, pulling tightly as before, and tacking each strand. Weave on the under as well as on the upper side.

When completed, the chair really has two woven seats with a small space between. This makes a seat both strong and lasting, as well as one that looks well. —GRACE R. SCHOETTLER, Buda, Ill.

Locking Screw Hooks

OUTSIDE window screens are hung ordinarily at the top and held in place at the bottom with screw hooks and eyes. Quite often children playing at a window will undo the hooks and push out the screen. To prevent this, simply twist back the screweyes with a pair of pliers a quarter turn over the hump of the hook, as shown. This locks the hook in place.—LOUIS SCHNEIDER, Clinton, Mo.



Trimming Wallpaper

ONE of the most tedious tasks in wallpapering a room is to trim the selvage edges. If you hold the paper so that the light from a window or a lamp will shine through from the other side of the paper, you can follow easily the straight edge of the pattern with your shears, because it will show through.—A. M. SMYTH.

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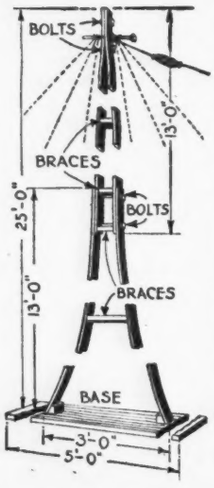
Flooring Strips Used in Building Neat Radio Antenna Mast

A MAST 25 ft. high for supporting a radio antenna can be made of four strips of flooring, each 13 ft. long and 3 in. wide. In the installation shown, the aerial is of the umbrella type, so that the wires act as stays. It has proved very satisfactory in actual service and, painted white, it looks surprisingly well—even better than a regular one-piece mast.

Two of the strips are bolted together at one end with two ¼-in. carriage bolts, the first 3 in. from the extreme end and the other 6 in. from the first. The other two ends of the two strips are spread apart and two pieces of 1-in. wood are nailed in 1 ft. apart. Then two similar strips of flooring are bolted outside the first with ¼-in. carriage bolts running clear through from side to side. Two bolts are used, placed as close as possible to the spacing blocks. When these are pulled up tight, the joint is stiff and strong.



Mast of flooring for an umbrella aerial

The lower ends are spread apart about 3 ft. and bolted to blocks, which are bolted in turn to a piece of 1-in. lumber about 5 ft. long and 10 in. wide. Two bracing blocks are nailed in halfway between the bottom and the middle joint and halfway between the joint and the top. In putting them in, make them wide enough so that they will have to be forced in place, slightly spreading the strips apart.

There should be washers under all bolt-heads and nuts; all nuts should be pulled down as hard as possible without splitting the wood; and the wire stays should be attached in such a way that they cannot cut into the wood. A simple way to attach the stays is to hook them over a long bolt that has been run through the top of the mast and clamped in place with a nut and washer on each side.—H. G.

Soldering Small Objects

WITH a pair of pliers and a gas-stove I have soldered very small parts together easier and more quickly than could have been done with a soldering iron.

To solder an upright piece to a flat piece, for example, clean and apply flux in the usual way, set the parts in correct relation to each other, place fragments of solder against the joint and then, with the pliers, hold the parts over the gas flame for a moment. The solder will melt and flow into the joint.

Flat pieces are joined by placing a scrap of solder between them, heating them over the flame and pressing them together with the pliers. Provided heat will not hurt the parts, this is often a convenient method.—E. A. M.

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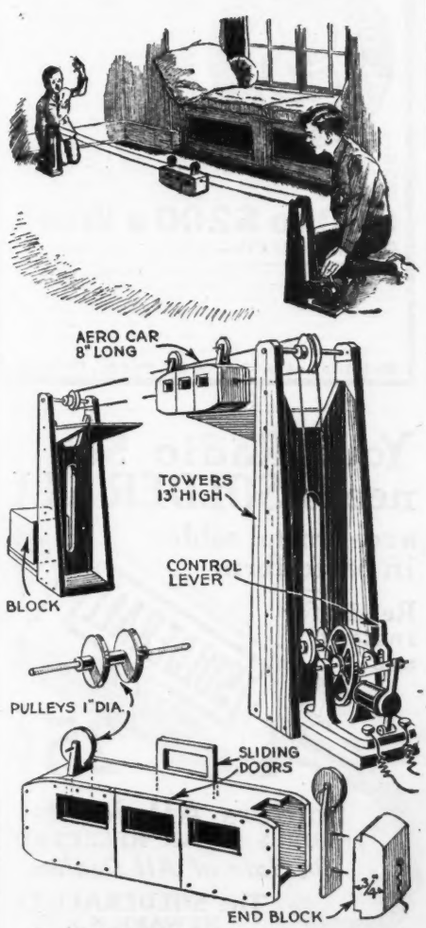
Miniature Aero Car Driven by Toy Electric Motor

By Donald W. Clark

NOW that aerial cable cars are being given much publicity, as in the description of the Chamonix line in last month's POPULAR SCIENCE MONTHLY, boy engineers will find the building of a toy aero railway a fascinating problem.

The aero car and the two towers that support the cable are built mainly of thin wood; that taken from packing-cases and cigar boxes will do nicely. The cable itself is fishline or strong cord. A toy motor of any type provides the power.

The car is 1¾ in. wide, 2½ in. high, and 8 in. long. The ends are two blocks cut



Boys interested in the striking cover of the April number of *Popular Science Monthly* will enjoy building this aerial railway

out like the one shown detached in the lower part of the illustration. The top, bottom, and sides are ⅛-in.-thick wood. The pulleys, which are 1 in. in diameter, are merely grooved wooden disks on wire axles. Each is mounted in a slot in a piece ⅛ by ⅞ by 3¼ in., which is nailed to the end block, as indicated.

The sides are made at first as if there were no doors. In assembling, however, no nails are driven where the doors are to be cut out. It is then possible to cut the doors through with a backsaw or a sharp penknife, making the cuts at a slight angle like a dovetail. This allows the doors to slide up and down. To prevent them from falling out, a small piece of brass or tin is

(*Continued on page 130*)

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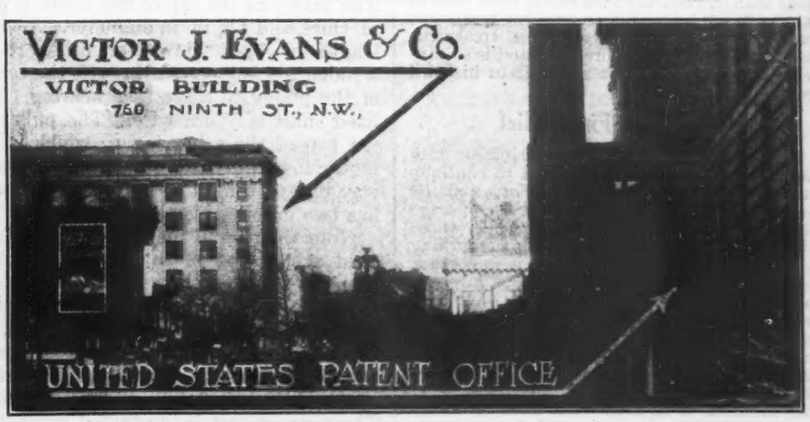

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I NOTE THESE 7 SIGNS IN MEN PAST 40

By Byram C. Kelly, A. M., L. L. D.

I am past 40 myself. I had begun to wonder when I would begin to break—to lose my old-time pep and aggressiveness—when, through a mutual friend I made the personal acquaintance of a certain member of the American Association for the Advancement of Science, whose wonderful work I had heard of. I made a trip to his laboratories and the things I learned should interest every man approaching or past the prime of life. Surprising as it may seem, nearly two-thirds of all men past a certain middle age suffer with a disorder of the prostate gland.

Common Middle Age Ailments

Here is an important cause for many conditions which heretofore have been taken for granted as old-age ailments—sciatica, aches in back, legs and feet, frequent nightly risings, nervousness and irritability, and frequent dizzy spells, indicating high blood pressure. Constipation, headaches and depressed spirits often go along with it. But my visit would have been in vain had I not learned of an amazing treatment that relieves prostate trouble—a treatment that reaches this gland directly—and is so convenient that anyone can apply it in his own home.

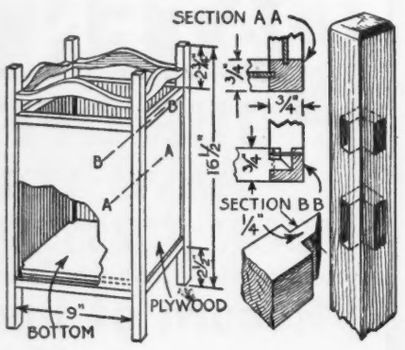
10,000 Men Find Relief

I know too plainly the effects of prostate gland disorder when it is allowed to continue unabated. I know of the operations and the common saying among many that the average life after this operation is only two or three years. That is why I am doing everything possible to let people know of this important discovery. Statesmen, bankers, lawyers, doctors, men from every walk in life have used the method with success. I have read hundreds of letters from gratified men. One I remember in particular was from a Colorado man which says, "73 years young is my age. Yet for years I suffered with prostate trouble. Used medicine to no avail—had about given up hope when a doctor recommended your treatment." Just think of a man 73 years old restored to the health and buoyancy of youth—without drugs, electric rays or books.

All Explained in Free Book

If you have prostate trouble, if you suffer with any of the ailments mentioned above, you should not lose a day in finding out about this wonderful new method. Send immediately for an interesting, free book called, "Why Many Men Are Old at 40." It describes this splendid treatment and shows you how you may regain much of your youthful vigor. Send your request to the Electro Thermal Company, 4033 Main Street, Steubenville, Ohio, the concern that is distributing these books for the author. There is no obligation. If you are not interested yourself, you may be able to do an "older" friend an immeasurable benefit by showing him this article.

Strong Waste-Paper Basket Built of Contrasting Woods



BY FOLLOWING the details above, any amateur woodworker can make a wooden waste-paper basket that is both durable and attractive in appearance.

In this case the posts are teak and the panels of a light-colored contrasting wood. The posts and rails could be any dark-colored wood, such as walnut, or birch or whitewood finished like mahogany. The panels preferably are light oak or birch 3-ply veneer ⅛ or 3/16 in. thick. The tenons are held with brass pins punched below the surface after the joints have been glued up. The loose bottom can be removed quickly for dusting the lower corners.

Miniature Aero Car

(*Continued from page 129*)

tacked underneath the car, projecting just enough to act as a stop. It is not necessary to make two doors; in fact, the car will be a trifle stronger if there is only one.

The towers are 13 in. high. The main members taper from ⅞ in. wide at the top to 4 in. wide at the bottom and are ¼ in. thick. The base is ½ in. by 3 by 10 in. The pulley at the top of one tower is 3/16 in. thick and 1¼ in. in diameter. A ¾-in. length of ⅜-in. dowel or other round wooden rod is inserted through the center of the pulley to serve as a bearing. The fixed shaft is ⅛-in. wire. The pulley at the top of the other tower, which is the motor tower, is made in exactly the same way except that it is twice as thick and has two grooves instead of one.

Note that small metal plates are fastened at the top of the towers to act as bearings for the pulley shafts.

At the bottom of the motor tower is a countershaft composed of two 1-in. or 1¼-in. pulleys. The motor drives one of these pulleys and the other pulley drives the double pulley at the top of the shaft. The countershaft is illustrated separately as one of the details on the preceding page.

Three separate belts are used, one connecting the motor and the countershaft, another connecting the countershaft and pulley at the top of the motor tower, and the third, which is the car cable, extending between the two towers.

Both towers are fitted with bracket-like landing platforms. A block 2 by 3 by 4 in. serves as a weight to hold down the far tower, and both towers can, if necessary, be fastened to the floor. The car is operated by the control lever on the electric motor, which gives movement in either direction at various speeds.

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Child's Chair Is Cut from a Single Board

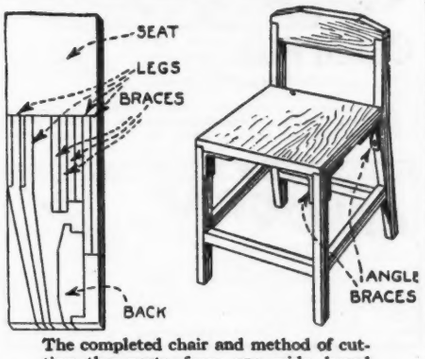
By Homer S. Trecartin

I HAD just read an article by a children's doctor telling of the discomfort caused to a child by having to sit on a chair too high for his feet to reach the floor and with no means for supporting them. So I decided to make a comfortable chair for my seven-year-old boy.

Finding no wood around except a ⅞-in. board 12 in. wide, I designed a chair that was made entirely from this piece, and it has proved properly proportioned for stability and comfort, looks well, is light enough to be moved by the child, is amply strong for an adult to use (and comfortable too), and is easily made.

The dimensions I found satisfactory are as follows: Seat, 12 by 13 in.; back legs, 27 in. long altogether, 18 in. to the seat notch; front legs, 1 by 18⅜ in.; back rail, 3 by 13 in. over all; front braces, 1 by 11¼ in., and side braces, cut to fit.

The front corners of the seat are notched with a chisel for the front legs, although the legs can be fitted without making even these simple mortises. The



The completed chair and method of cutting the parts from one wide board

"side braces" are left too long in the layout, as the easiest way to fit them is to hold them in position with one end against the front leg, and to mark with a pencil where to cut them to fit against the back leg.

After all the pieces are nicely smoothed with a plane, they can be assembled. If one has a brace and bits, or hand drills, long wood screws may be used; but sixpenny and eightpenny finishing nails will be much quicker. It is worth while to get from a hardware or 10-cent store about eight small angle irons, which should be screwed to the bottom of the seat and to the legs, and under the ends of the leg braces. I have found these fastenings to last better and to give greater stiffness than glued mortise and tenon joints, when knocked around as in a child's chair.

Painting or enameling is the best method of finishing. Contrasting colors, such as orange and black enamel, give a pleasing effect. Be sure to round off all edges well, and to sandpaper everything very smooth, and you will find you have created a lasting treasure for the child.

"HOW to Build a Bunny Rocker for a Small Child," by Kenneth R. LaVoy, and an article describing the construction of a unique gondola swing for children are two of the many play stories planned for summer publication.

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Power from the Tides

(Continued from page 30)

In most instances employment is made of "stop-logs" to form a removable dam between two stone piers. When the creek has filled up to the level of high tide, the logs, inserted in grooves cut in the piers, make a fairly serviceable dam, retaining the water as the tide falls. When the tide has ebbed, an outlet gate is opened, and the impounded water is discharged through a wooden flume upon a wooden wheel 18 or 20 feet in diameter.

What has been accomplished for so many years by primitive methods and with the help of equally primitive apparatus, certainly can be achieved, in the light of modern scientific knowledge, with the wonderful hydroelectric machinery already in use.

THE moon is a lazy orb, serving little useful purpose except to give us a certain amount of nocturnal illumination. We have persuaded it to grind grain and saw planks, but it can be compelled to operate mechanical plants on a large scale. It can be made to run the machinery of our factories, illuminate our cities, heat our houses, drive our railway trains, and lift the elevators in our skyscraper buildings and apartment hotels.

There will be no lack of locations, in estuaries and straits, where tidal developments on a great scale can be established. Why, for example, should not the tides of Delaware Bay and of the Chesapeake be harnessed? Experts say there is no reason why they cannot be.

In the meantime, the attention of hydraulic engineers naturally is attracted to places where the tidal rise and fall is extraordinarily great. The Bay of Fundy is one of them. Another is at St. Malo, on the Rance River, in France, where the sea, running up a big estuary, gives the waters a 40-foot lift. Another is in England, where the damming of the Severn is expected to yield continuously a power greater than is derived from all the hydroelectric developments of Niagara. In Cook's Inlet, southern Alaska, the tidal range is the greatest known anywhere, attaining a maximum of 50 feet when moon and sun pull together.

MANY years ago, an American warship was anchored in a Chinese river, and a cannon, which was being hoisted on deck, fell overboard. The American officers, after trying many expedients to recover the weapon, gave it up. Presently, however, half-a-dozen Chinamen offered to undertake the job.

They fetched a float and tall sheer-legs, stuck the latter deep into the mud of the river bottom, and, at low tide, attached the gun to the float with ropes. The next high tide raised the float, and the gun with it, six feet. The gun was fastened at that height, and, by repeating the operation again and again, it was soon brought to the surface. Then timbers and more timbers were shoved under the float, until, with more of the same business, the gun was lifted to the level of the ship's deck and shoved aboard.

No power? There was unlimited power. All the power of the pull of the moon was available to do the lifting.

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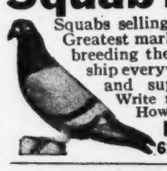

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Can Science Save a Crowded World?

(*Continued from page 40*)

Centralized distribution of light and heat already has been achieved. All that remains is semi-automatic control for the colossal rabbit warrens such as future apartment houses and office buildings will be.

Fifty years from now, feeding millions in a metropolis will require extraordinary efforts in the way of countrywide intensive farming. Getting food to the man, getting the man to his job, will intensify the pressure on transportation. F. H. Hardin, chief engineer of motive power and rolling stock of the New York Central Railroad, visualizes a new scheme of railway transportation within the next 25 years.

He predicts that the human element eventually will be eliminated. Automatic controls, radio signals, complete electrification, are some of the items that will rush the bread of life to helpless dwellers in great conurbations.

WE MAY add that the human element will be eliminated from many other phases of life. The iceman, the gasman, and the milkman all will disappear as did the lonely watcher of our forefathers who at midnight called "All's well!" In their places will be super-organizations of supply, central heat, and refrigeration.

Indeed, men will live in a super-world. Super-power that will save 30,000,000 tons of coal a year already is Herbert Hoover's pet idea. Most of us will live to see it. It is simply a plan to lump the fuel and water energy of a section of the country and cheaply distribute both in the form of electric current as we now feed light and water to a small community.

There will be the super-automobile, costing but a song, that will never need repairing; the super-radio, bringing life-like talking movies into our homes; the super-plane and dirigible, both safe and swift; the super-surgeon, who will rid us of our useless organs at birth; the super-government to deprive us of the morning daily's vivid headlines.

Wars will have become a rare indulgence; disease practically unknown. Medical science, which already has done wonders for the infant-mortality rate and added 10 years to our span of life, will have nearly doubled the terrific acceleration with which population now increases.

THE business center, with its irradiating lines of manufacture and power production, will form a ganglion of intense human toil. Traffic and communication both within itself and to other business centers of the world will be masterpieces of mechanical efficiency.

Actual business structures will be skyscrapers from 75 to 150 stories high (one of 80 stories already has been designed). Moving sidewalks, stairs, individual helicopters, all will aid the individual to move swiftly and in comfort within the precincts of his special interests.

Improved methods of machinery and more efficient utilization of the world's sources of power will by that time have reduced the working day to but a few

(*Continued on page 134*)

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Are pipe-smokers less selfish than other people?

A lot of evidence points that way—maybe some reader can explain it

One can't imagine an ordinary citizen going about telling all his friends where he bought the suit that fits him so well or urging upon his acquaintances the merits of a certain make of shoes—but it's *different* with pipe-smokers and their tobacco.

Most of them, apparently, won't rest until they have shared their favorite tobacco with every smoking friend.

Read this:

Barrington, Ill.

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Richmond, Va.

Gentlemen:

I wish to take this opportunity of telling you what I think of Edgeworth. Until some months ago I smoked other brands of pipe tobacco and never was satisfied with any of them—never could get any satisfaction from a pipeful. I just happened upon an advertisement one day of yours and asked you to send me some free samples. And ever since I have been smoking it with great pleasure.

At the present time I am working with the Telephone Company and out of twenty men in the gang, fourteen of them smoke Edgeworth now. They never heard of it until I came into the gang.

Yours with satisfaction,
Arthur H. Pflum.

We have chosen Mr. Pflum's letter from among hundreds because he is typical of Edgeworth smokers in that, being happy in his own choice of tobacco, he wants everybody within reach to share his happiness!

We are glad to know that Mr. Pflum has created fourteen new Edgeworth smokers, for experience has shown that they will continue to smoke Edgeworth; and every *permanent* Edgeworth smoker is living proof that we know our job.

Of course, we don't expect *every* man to like Edgeworth—but fourteen out of twenty is a pretty good showing.

We'd like mightily to have you pass judgment on Edgeworth. Perhaps you can tell us, then, just what it is that causes our tobacco to make friends and hold them.

Let us send you a free sample of Edgeworth so that you can decide whether you are one of six or one of fourteen. Address Larus & Brother Company, 59 South 21st Street, Richmond, Va.

To Retail Tobacco Merchants: If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Ready-Rubbed for the same price you would pay the jobber.

Can Science Save a Crowded World?

(*Continued from page 133*)

hours. From this will arise the improvement of replacing the working day by the working *interval*. That is to say, a man will work three days a week or 10 days a month and be free to enjoy life the remainder of the time. High-altitude commutation planes will transport him to and fro at 500 miles an hour.

The residence suburb of the future will be a vast boulevarded park filled with flowers, amid which dwell the healthy men and women of the future. There will be golf courses enough for all, and playgrounds almost unlimited in extent for pink-cheeked, laughing children. In this section there will be no shops nor machinery nor toil of any sort. Heat and light will be sent by radio from far distant generating stations to all the houses. Simply by pushing a button one will be able instantly to summon such comforts day or night.

EVENTUALLY, the food supply no longer will be a problem of straining every nerve to rush great quantities of inefficient human fuel like meat and bread into the home, for the problem of chemical nutrition will have been solved. Such authorities as Irenée du Pont, Steinmetz, Metchnikoff, and Lodge already have predicted the balanced ration of synthetic essences that will reduce the volume of food while increasing immensely relative nutrition. It sounds like a pretty dull diet, to be sure. But our present menus would look equally uninteresting to the gorging Visigoth.

Steinmetz pictured a sort of "bacterial bean"—clusters of microscopic bodies creating a protein food as alcohol now is made by fermentation. Mr. Du Pont points out that "a mountain of limestone and a waterfall" supply the chemical raw material and energy for sugar and for starch. Luther Burbank promises us strawberries "the size of apples."

A corollary of chemical feeding will be eradication of fatigue. Here again we already have gone far along the way. Fatigue is but a poison. Acid sodium phosphate has been found to be an antidote. A single dose of it will increase a man's endurance 20 per cent.

SLEEP will be more a pleasure than a necessity in the future. Hence there will be no bedrooms, dining-rooms, nor kitchens. Rest will be taken in a secluded corner of the home with talking-movies, opera, and photographic news (up-to-the-minute) to make the lazy hour a pleasant one.

There will be many startling novelties. Already in England has appeared the radio-controlled airplane. By the next generation we shall have the roadster-plane that can be driven to one's place of business and sent back home *alone* for family use.

There will be items like radio alarm clocks; wireless percolators and toasters; local radiotelephones with automatic control; political campaigns by radio; pocket movie cameras; communication with

(*Continued on page 135*)

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Can Science Save a Crowded World?

(*Continued from page 134*)

planets; control of weather; crops that grow overnight; lumber trees produced in a single season.

Today's untapped sources of power will have been opened. Heat from the tropics may be stored and brought north. The capacity of plants for utilizing sunshine certainly will be turned to human advantage. Wind and tides both will be harnessed. Immeasurable atomic energy will be released.

How fanciful it all sounds! More like the romantic dream of a mind like H. G. Wells'. Yet how cleanly logical in every single item herein promised for the future!

ONLY turn back into the past. Think what things were like in 1776, less than 150 years ago. No power, no light, no daily news. No steamships, no movies, no telegraphs. No anesthetic. No electricity. No fuel oil. Why, if a man had dared in public to predict what you and I have seen this day, he straightway would have been jailed!

And yet, for all its seeming complexity, tomorrow will be an infinitely simpler life than that we lead at present. For we shall have learned our awful lesson of slums and filth and nervous wreckage. Such a thing as the human treadmill will be abolished forever. Education will have become the popular pastime, and healthful games, with just enough of workdays now and then to keep the mind alert, will be the monthly diet.

So shall Science, eventually, thus save us from ourselves. And Science alone shall bring the universal peace we so pathetically long for now.

Finds Diet of Dead Germs Will Kill Live Ones

THE possibility of vaccinating against certain diseases by eating the dead germs or rubbing them on the skin is suggested by Prof. A. Besredka, a Russian, working on the staff of the Pasteur Institute, Paris, as a result of experiments upon animals and subsequently with human beings. His conclusions are considered revolutionary in their application to the prevention of disease.

Professor Besredka asserts that immunization is effected by bringing the immunizing substances into contact with the tissues where the disease would first enter the body, rather than by injecting them under the skin.

For example, it was found that guinea-pigs could be protected against anthrax, a disease to which they are especially subject, by applying killed anthrax germs to the surface of the skin where the active germs usually find lodgment.

Experiments with cholera, typhoid, and dysentery, all diseases that enter the body through the walls of the intestines, have shown that protection may be obtained by administering the vaccines by the mouth, the immunity resulting, according to Professor Besredka, from the effect of the vaccines on the intestinal cells rather than on the blood.

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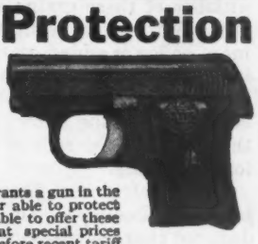

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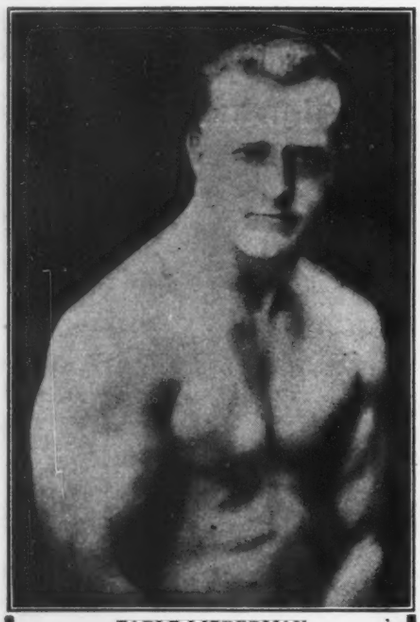

EARLE LIEDERMAN
as he is today

How Do You Look In a Bathing Suit?

The good old swimming days are here. Oh boy! But it's great to rip off the old shirt, into your suit and—SPLASH!! But what a shock to some of the poor girls when they see their heroes come out with their flat chests and skinny arms, instead of the big husky frames they expected to see.

YOU ARE OUT OF LUCK

Don't try to make excuses. You are just out of luck. It's your own fault. You can't blame anyone but yourself. What are you going to do? She is going to find you out.

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It's not too late. Snap into it and I can save you yet. It means hard work and plenty of it, but wait till you see the results.

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My job is to build muscle. That is why they call me the muscle builder. In just 30 days I am going to add one full inch to your biceps. Yes, and two inches on your chest in the same length of time. But that's only a starter. I am going to broaden out those shoulders and shoot a quiver up your old backbone. I am going to put a man's neck on you and a pair of legs to balance the strong, sturdy body they support. You will have a spring to your step and a flash to your eye, radiating the dynamic life within you. Before summer is past you will never recognize your former self. You will have a strong, sturdy, virile body to be really proud of. You will be admired for your perfect manhood—while others are given glances of pity and scorn. This is no idle prattle, fellows. I don't just promise these things. I guarantee them. Are you with me? Let's go. Time is short, and we have a job to do.

Send for My New 64-Page Book "MUSCULAR DEVELOPMENT"

It contains forty-three full-page photographs of myself and some of the many prize-winning pupils I have trained. Some of these came to me as pitiful weaklings, imploring me to help them. Look them over now and you will marvel at their present physiques. This book will prove an impetus and a real inspiration to you. It will thrill you through and through. All I ask is 10 cents to cover the cost of wrapping and mailing and it is yours to keep. This will not obligate you at all, but for the sake of your future health and happiness, do not put it off. Send today—right now before you turn this page.

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Dear Sir: I enclose herewith 10 cents, for which you are to send me without any obligation on my part whatever, a copy of your latest book, "Muscular Development."

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The Honey-Bee

(Continued from page 43)

to remove. Still, they cannot be left there to decay, for the bee is a stickler for sanitation. In such cases a sanitary corps, which performs a similar service when any member of the hive colony dies, builds a tomb of wax about the body, sealing it as tightly as ever the tomb of a Pharaoh was closed.

While studying the life of the bees in the hive, Uncle Sam has not neglected their activities outside. By means of electric timing devices the departure and return of a bee are clicked on an automatic register. This delicate apparatus has shown that the honey-seeking flight of the bee is not so long as has been supposed—that the average time of absence from the hive is between five and seven minutes although the journey in search of honey may be as long as half a mile. The bee is a swift worker.

Experiments are under way to determine the influence of ultra-violet light on the bee. Bees are practically color-blind, and the only possible explanation of their attraction to flowers of different colors seems to be that they are able to perceive rays beyond the humanly visible spectrum. This theory, advanced by Dr. F. K. Richtmyer of Cornell University and Dr. F. E. Lutz, entomologist of the American Museum of Natural History, seems to be well grounded in fact. If the work of the government experts confirms this belief, it well may lead to a special development of flowers rich in nectar and giving off strong ultra-violet rays; perhaps colorless to our eyes, but potently attractive to the bees' many-faced visual organs.

THESE important new facts about the attraction of flowers for bees, were the result of ingenious scientific detective methods devised by Doctor Lutz. He found that he could trace and record every movement of a bee on its honey-quest by examining the pollen it gathered on its legs during visits to the flowers.

The short-cut invented by Doctor Lutz enables a scientist in his laboratory to gather facts in one day that the field worker could not collect in a year. Each time a bee visits a flower, it churns up the pollen grains in the blossom, and a number of these grains stick to its hairy legs. With every visit to a new flower, more pollen is added, until it accumulates in a fluffy yellow ball on the rear legs of the insect, as shown on the cover of this issue. Returning home, the bee deposits this pollen in the cells of the hive as food for the young.

Since each kind of flower has a different form of pollen grain, Doctor Lutz rightly deduced that the bee's collection of grains should indicate just where it has been. By brushing off the legs of a bee and examining the sweepings under a microscope, he can tell from the character of the grains just what flowers the bee has looted of honey on its last flight.

Similarly it is possible to keep a record of a bee's movements for months by the pollen deposits it leaves on the honey cells. Examination of the cells under the microscope reveals a complete "finger-print" record of the honey-maker.

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Howard Radio Company
4244 N. Western Avenue CHICAGO

Adventures in Home Ownership

(*Continued from page 37*)

"Now you're talking in my language," approved Jim heartily.

"My suggestion is this," I explained. "Buy one of these houses and pay $4000 cash. A bank will gladly lend the balance of $3000 on a three-year first mortgage at 6 per cent, costing you $180 a year. Taxes, insurance, and upkeep hardly will exceed $280 more, or a total expenditure of $460 a year.

"You're allowing nothing for amortization," Jim interrupted.

"Not so fast; the plan is but half unfolded," I replied. "My idea is for you to make no further principal payments. When your salary is raised, you want to sell this house and get a better one. The mortgage on the house will help to sell it. When the time comes, whoever buys it need put up only as much as you did. His mortgage on the balance already is placed, and when the three years it has to run have expired, he can renew it easily on an amortization plan such as we have already talked of. Meanwhile you'll be living in your own home pretty cheaply."

"BOY, you've solved the problem!" cried Jim, with a resounding slap on my back. "Let's see the houses. What do you say, Marion?"

"Well, I suppose we must," she agreed regretfully. "Of course you men know best, but I do love this house."

She dabbed furtively at her face with a tiny handkerchief, but gave us a forlorn little smile as she trudged bravely out of the house.

"Hop right into the car," I hastened to say, opening the door. "We'll be there in a jiffy."

Reaching the development, we came first to a pleasing little six-room semi-bungalow of stucco in the English-cottage half-timber style, priced $7750 on our list.

"This isn't the house I had in mind," I announced; "but let's take a look just for the fun of it. The plan offers many step- and labor-saving features."

Entering the living-room through the front vestibule, I pointed out the English type recessed fireplace with brick hearth slightly raised, and the porch opening off at the side.

"IT CERTAINLY is quaint and charming," Marion commented, without enthusiasm. "A bedroom on the first floor, and a delightful winding stairway," she added, passing out into the back hall. "Oh, and a toilet room, too. How convenient!"

The unique thing about the house, I showed them, was a combined kitchen and dining-room, English-cottage style, a screen being set up across the arch between the two rooms when desired.

Marion laughed. "How foreign and funny," she said. "It saves steps, no doubt, and probably cost, but I don't like it, all the same. Let's look upstairs."

There we found two large bedrooms, somewhat irregular in shape. plenty of windows and closet space, a good bath-

(*Continued on page 138*)

Circuits Unequaled
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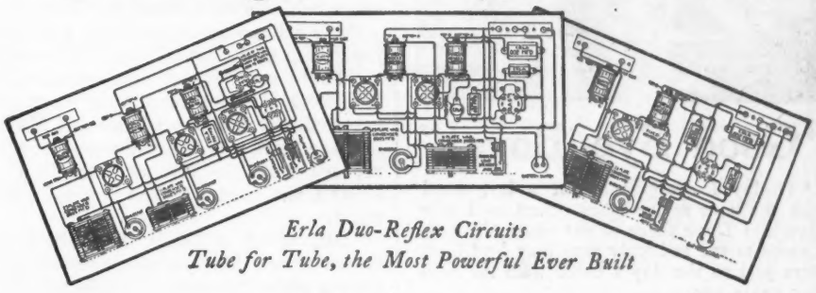

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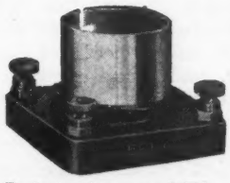
Superior quality of Erla audio transformers stands clearly revealed in their ability to amplify three stages without flaw. $5



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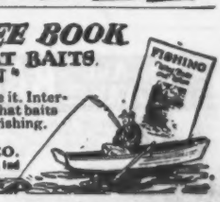

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"Good Bye, Boys!"

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"When I started here I was put at a desk and given certain routine things to do. But after a few months I began to realize that I was nothing but a human machine and that I couldn't expect to advance that way.

"So I wrote to Scranton and arranged for a spare-time study course that would give me special training for our work. Why, do you know, it gave me a whole new interest in our business? In a few months I was given more responsibility and more money. Since then I've had three increases, six months ago I was put in charge of my department, and now my big chance has come—I'm to be manager of our Western branch at $5000 a year! It just shows what spare-time training will do."

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Adventures in Home Ownership

(*Continued from page 137*)

room, with clever fixtures and linen closet.

"It's a pleasant little place, but rather jogged up and queer," was Jim's verdict.

"There are several nice features, but I think I'd prefer something more characteristically American," decided Marion.

Since that was the judgment of all of us, we lost no further time in going around the corner to the house I had in mind.

"Oh, what a lovely little box of a home!" cried Marion, as there came into view a white painted gambrel-roofed cottage of the Dutch colonial style, with attractive green shutters and a background of thrifty young shade trees. "I know that's the one. Am I right?"

I told her it was.

"But I thought we'd have to take some ugly little shanty," she explained.

"THE great advantage of this Dutch colonial type," I said as we looked about the ample lot, "is that it offers so much for the money in room, real comfort, and convenience. It has six good rooms and bath, a full basement, an attic and 10 closets—count them yourself."

"One thing I miss," broke in Jim, "and that is a porch."

"Yes," I agreed, "a permanent owner would want to add one outside the living-room. For a year or so, however, a lawn swing and chairs under these trees might take its place. The sleeping porch also is missing. Otherwise the floor plan is much like the house of Marion's choice."

"So it is!" cried Marion, as we went inside and she began dancing about the rooms of the lower floor with reviving spirits. "Here's my big living-room and fireplace right over again. A pleasant dining-room—and the cutest kitchen," she called from the rear of the house.

Proceeding more slowly, Jim and I appraised the hardwood floors and woodwork, the paint finish, electric fixtures, and wall-paper, and found them good. In the basement was an excellent heating plant.

"Everything looks good to me," commented Jim. "Let's climb to the second floor."

THERE were three light and airy bedrooms of good size, with ample closets and a well equipped bath. On careful inspection, Jim and I decided that the fixtures and plumbing measured up to the heating plant.

"My mind's made up," said Jim after a final survey. "What do you say, Marion?"

"I think living here for a year or so, with the prospect of a better house soon, will be a delightful little adventure. I had no idea when I left that other house," she continued, "that we ever could find anything so much like it for so much less money. I almost expect when the time comes I shall feel sorry to leave it."

Jim fairly beamed.

Read, in next month's issue, how Jim and Marion later built themselves a permanent home.

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A Radio Tuning Unit

(*Continued from page 74*)

certain winding. To determine this figure, if you are using No. 20 wire, multiply the number of turns by the diameter of the tube in inches, and divide the product by 1146. For No. 22, the product of the number of turns and the diameter of the tube should be divided by 1834. For No. 24 it should be divided by 2904.

In the new combination unit, No. 22 d.s.c. wire was used. The tube on which the *A* and *B* coils were wound was four inches long, while that on which the *C* coil was wound was two inches long. The rotors were 3¼ inches in diameter with a half-inch winding space on each side of the shaft, making a total winding space of one inch, providing for 33 turns of the wire.

IN WINDING the coils, taps are easily made, as shown in detail 2 of Fig. 1, by holding the wire taut and twisting a loop in it with a bent piece of heavy wire.

To anchor the ends of the windings, it is necessary only to drill two small holes about one eighth inch apart. At the beginning of the winding, the end of the wire is passed from the outside to the inside of the tube, through one of these holes, then up to the outside through the other hole, in again through the first hole, and out again through the second hole. A loop to serve as a tap then is made in the end that has been brought out through the second hole. The other end of the winding can be anchored or fastened in the same way. This type of fastening offers great strength.

To anchor the ends of the rotor winding, drill two holes on opposite sides of the rear rotor shaft. Twist two small loops in the form of a bow, as shown in detail 3 of Fig. 1, leaving a piece of wire about a half inch long to solder to the ends of the flexible rotor lead. Then wind half the rotor winding, inserting the end of the wire into the center of the rotor through a small hole drilled at the end of the winding. The other half is wound in exactly the same way and in the same direction, starting from the outside and winding toward the center of the rotor. The end of this half of the wire also is inserted into the center near the point where the end of the other half was inserted. The two ends are soldered together on the inside of the rotor, as shown in detail 4 of Fig. 1.

THE rotor leads should be made of flexible wire usually referred to as "pigtails." To make sure of good contacts, the insulation at the ends should be pushed back slightly, exposing the strands of the wire. A piece of small bare copper wire, from No. 24 to No. 26, then should be wound around the end, starting about three-sixteenths back of the end of the insulation. This serves the double purpose of binding the insulation and wire together to prevent raveling of the insulation and also to serve as a positive connection between the lead and a terminal.

The ends of the rotor leads may be connected with isolated screws fastened near the edge of the tube, as shown at detail 5, Fig. 1, so that connections from other parts of the circuit to the rotor

(*Continued on page 140*)

$1662.00 Earned IN ONE SEASON

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A wonderful invention that sharpens lawn mowers scientifically—quickly—perfectly; does the work as nothing else can.

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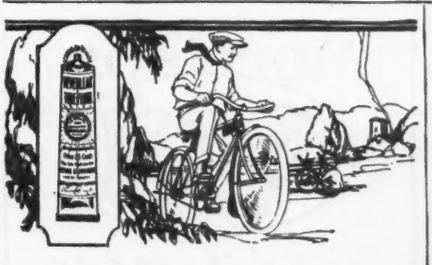

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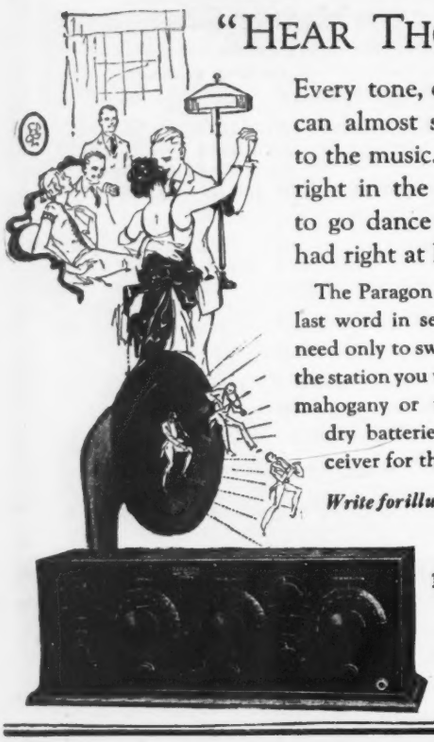
3-CIRCUIT RECEIVER



"HEAR THOSE SAXOPHONES!"

Every tone, every note clear and sweet. You can almost see the musicians swaying in time to the music. It's just as if the orchestra was right in the room with you. Why pay money to go dance when the best in the land can be had right at home over the radio?

The Paragon 3-Circuit Receiver here illustrated is the last word in sensitivity, selectivity and simplicity. You need only to switch on the tubes and set the dials for the station you want. The cabinet is of the highest finish mahogany or walnut and includes compartment for dry batteries. The Paragon is the ideal Radio Receiver for the home.

Write for illustrated Bulletins of Paragon Radio Receivers

ADAMS-MORGAN CO.
18 Alvin Avenue, Upper Montclair, N.J.

Paragon Model
RB—2
Price $135.00

A Radio Tuning Unit

(*Continued from page 139*)

winding can be made at these points.

For best results the rotor should be of the type that has separate shafts for back and front. The rear shaft must be hollow so that the rotor leads may be taken to the outside connections.

The rotor bearing is made easily. As shown in the photograph, a slot is filed in one edge of the stator tube to receive one end of the rotor shaft. Another similar slot is filed at the opposite end of the tube to receive the other end of the shaft. A hole then is drilled at each side of the slot. In these holes are inserted screws to serve as anchors for a wire that loops over the shaft of the rotor to hold the shaft in place.

ONE of these screws (as at 6, Fig. 1) is left rather long to serve as the stop for the projecting piece of wire (7), soldered on the shaft. This arrangement prevents the shaft from turning through more than one revolution and eliminates the tendency of the rotor leads to twist and break.

In selecting wire for winding the coils, slight differences in the type and size of wire will not affect the operation of the coil to any great extent. Usually, best results are obtained by using No. 22 s.c.c. or No. 22 d.s.c. wire.

In general, there should be about 40 turns in the primary winding, where a four-inch tube is used and where a .0005-mfd. variable condenser is to be connected in parallel with the coil. When a .001-mfd. variable condenser is to be used in series with it, there should be 70 turns. From 40 to 50 turns in the secondary winding with a .0005-mfd. variable condenser across the coil, and from 30 to 40 turns on the tickler coil usually will give best results.

If no condenser is used in the primary circuit, about 50 turns should be used in this winding.

The latest practice in winding is to tap the coil at every 10 or, at the most, every five turns, and use a variable condenser of the Vernier type to provide the finer tuning. In this way only one switch is needed.

THE tension required to keep the rotor at whatever position it may be placed; is provided by the simple expedient of making the spacing washers, one of which is shown at 8, Fig. 1, between the rotor and the stator of such a thickness that the distance between the outside faces of the washers is slightly greater than the inside diameter of the tube. This makes it necessary to spring the tube slightly to fit the rotor assembly into place. The elasticity of the tube is sufficient to provide a firm, even tension.

When the extra stator winding *C* is to be joined with the main stator tube, two small connecting links, as shown in detail *9* of Fig. 1, are used to connect the tubes.

Means for fastening the stator to the baseboard in mounting the unit is provided by the wire bent as shown at 10, Fig. 1.

The variocoupler or double rotor tuning unit may be mounted on the panel by means of the bent wire supports shown at 11, 12, 13, and 14, Fig. 1.

Sir Oliver Lodge says he hopes this discovery will not become generally known until mankind has sufficient wisdom to handle the power that it will loosen. But scientists have already tapped this source of power! Not yet harnessed perhaps but yet plain enough that ANY AVERAGE PERSON can to a large extent demonstrate it in daily life.

With the use of this ENERGY you can accomplish anything humanly possible. This FACT has been proven by the actual experience of thousands of people during the last twelve months in whose hands we freely placed this amazing discovery. You not only "get the idea" but it applies itself to your affairs within a few days.

Nothing Impossible

Literally thousands of people changed their lives almost overnight by this revelation.
With this secret Col. Adams of Salt Lake City made over $4,000 in a few days.

Unless this power will immediately and practically WORK for you, unless you can demonstrate it as clearly as a child demonstrates electricity by turning on the electric light, IT IS WORTH NOTHING TO YOU. For all men are not equal. Doubt, fear, suspicion, distrust, irresolution are chains that make slaves of many.

Five Days' Free Trial

Simply send your name, postcard will do, we will mail you postpaid, CLEAR, POSITIVE, SIMPLE instructions that you can begin applying IN A VERY FEW HOURS. You have five days to study and examine it without cost. If it proves valuable in obtaining concrete results we leave it to you to pay us within 5 days what in your judgment it is actually worth to you or what you honestly can afford to pay. If you think it is worth nothing, pay nothing, simply return it. This plan seems strange and unusual. But the power and secret are ALSO strange and unusual. You WRONG only yourself if you delay.

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The market on Morrison is active. Our merchandising plan will interest you. Write immediately for details and discounts.

MORRISON LABORATORIES, INC.
341 East Jefferson Ave. - DETROIT, MICH.

Earth's Highest Citadel

(*Continued from page 35*)

sequent reception of too little oxygen. Its symptoms are extreme lassitude, weakness, mental fog, depressed spirits, and physical exhaustion after even the slightest efforts. Though the climber is constantly weak, tired, and sleepy, he cannot sleep except brokenly.

The terrific cold—between 20 degrees and 30 degrees below zero is the average temperature near the summit of Everest—saps the climber's waning strength. His hands and feet are likely to be frostbitten. And yet, anomalous though it may seem, the rays of the sun are beating down on him with terrific ferocity. He is perpetually in danger of collapsing from sunstroke. From the great expanse of glistening snow the rays of the sun are reflected into the climber's eyes. He wears smoked glasses, his cheeks and forehead are smeared with lampblack; yet there is always the danger of snow blindness.

NATURE, in a way, has supplied a compensation for the lack of oxygen in the atmosphere by causing the red corpuscles to multiply in the blood. These red corpuscles are the carriers of oxygen, and as they increase in number, of course, the oxygen supply of the body increases correspondingly. However, no man ever has been able to stay in extremely high altitudes sufficiently long to determine whether the multiplication of red corpuscles can progress to a stage that would make him immune to the debilitating effects of insufficient oxygen.

Physical suffering is the principal impediment to remaining near the peak. Besides this, conditions in the Himalayas are such that weather suitable for mountain climbing is not likely to last more than three or four days at a stretch.

TOWARD the end of the last climb, Bruce and Finch were progressing only 330 feet an hour. At that rate a little more than five hours would have been sufficient to enable them to negotiate the 1700 feet that stretched between their last stopping place and the top. Yet they were unable to make it. Physical man apparently had reached his limit.

But now Bruce and a dozen others are making another desperate attempt. Science has solved their difficulties as far as present-day knowledge can. The climb has been planned as carefully as a military campaign. Compressed oxygen in small, light tanks has been supplied to serve them in the thin air near the mountain top. Their food supply has been selected scientifically to furnish strength and energy when they have reached the limit of their courage and stamina.

Will they succeed?

They will if they can conquer Nature. Not Nature as represented by the towering majesty of Mount Everest, Titan of the earth's peaks, but Nature as exemplified in the indomitable spirit of man.

DID you read Raymond J. Brown's fascinating story of atoms in the April issue? If so, you won't want to miss his entertaining, understandable story of radium, the modern Philosopher's Stone—next month.

Super-service

Wide-awake radio fans prepare for clear reception of all programs by keeping the storage battery full-powered with the Tungar. For super-service the Tungar is used to recharge both radio and auto batteries. The result is longer battery life and more "pep"—plus convenience.

In homes with electricity Tungar recharges the run-down radio or auto battery overnight at a saving.

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Tungar is one of the many scientific achievements contributed by the G-E Research Laboratories toward the wonderful development of electricity in America.

Tungar Battery Charger operates on Alternating Current. Prices, east of the Rockies (60 cycle Outfits)—2 ampere complete, $18.00; 5 ampere complete, $28.00. Special attachment for charging 12 or 24 cell "B" Storage Battery $3.00. Special attachment for charging 2 or 4 volt "A" Storage Battery $1.25. Both attachments fit either Tungar.

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Enjoy a spring day at your favorite sport without suffering that disagreeaale setback. Have Absorbine, Jr. in kit or locker. Apply it promptly. As if by magic it prevents that stiff, lame feeling. You are fit as usual the next day.

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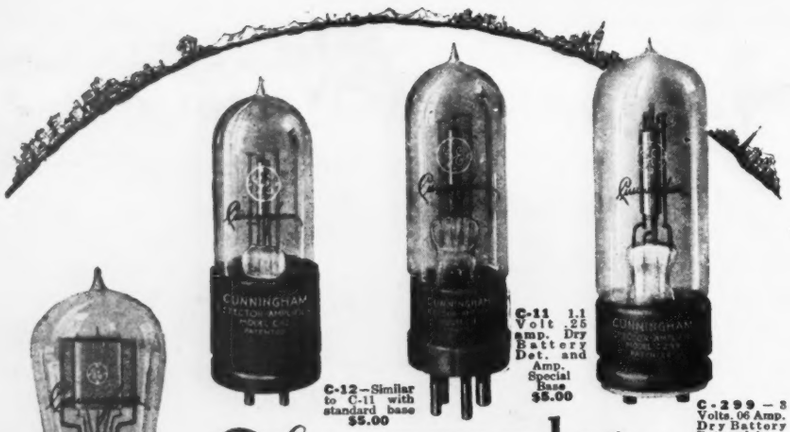
C-12—Similar to C-11 with standard base $5.00
C-11 1.1 Volt .25 amp. Dry Battery Det. and Amp. Special Base $5.00
C-299—3 Volts .06 Amp. Dry Battery Det. and Amp. $5.00

The complete line of Cunningham RADIO TUBES

FOR EVERY TYPE OF RECEIVING SET

WHATEVER type of receiving set or circuit you are using—one or more of these five Cunningham receiving tubes will be ideal for obtaining maximum distance reception with perfect reproduction of both voice and music.

Three of the five tubes are designed to use dry batteries for filament lighting. C-299, the latest development in Radio Tubes, is compact in design and highly efficient in operation as a radio frequency amplifier, a detector and as an audio-frequency amplifier. When used for the latter purpose, the output of two stages is sufficient for the operation of a small loud speaker.

The most remarkable feature of this tube is the new patented filament used which draws only .06 amperes at 3 volts.

C-11 is a dry battery tube with a special base for use in sets having special sockets. It is a good detector and audio-frequency amplifier. The filament is lighted from a single dry battery and draws .25 amperes.

C-12 is identical to C-11 in operating characteristics, but is mounted on a standard base to permit the use of a dry battery tube in sets equipped with standard sockets without the aid of special adaptors.

Whenever storage battery supply is available for filament lighting, the C-300 will be the best tube to use as a detector because it is the most sensitive for the reception of distant and weak signals.

Under the same condition, C-301A will be the best tube for amplification at either radio or audio frequency, because it gives greater gain per stage than any other tube on the amateur market. The new patented filament used, similar to that in C-299 draws only .25 amperes at 6 volts, reducing the necessity of frequent storage battery charging.

Patent Notices Cunningham tubes are covered by patents dated 2-18-08 and others issued and pending. Licensed for amateur, experimental and entertainment use in radio communication. Any other use will be an infringement.

The care and operation of each model of Receiving Tube is fully explained in our new 40-page "Radio Tube Data Book." Copies may be obtained by sending ten cents to our San Francisco office.

30 Church Street New York City N. Y.

C. J. Cunningham Inc.

154 West Lake St. Chicago, Illinois

Home Office: 182 Second St., San Francisco, Calif.

How to Make Your Watch Keep Good Time

(*Continued from page 38*)

In 12 months the balance wheel of your watch revolves a distance of 4800 miles. The movement of a locomotive's wheels is slow and clumsy in comparison, and yet a locomotive is oiled every few hours. All your watch asks is a tiny drop of oil not oftener than once a year; yet, if you are like thousands of watch users, you probably deny it even that much care.

If you want your watch to keep time, treat it gently and do nothing to disturb its calm. Probably the most destructive thing you can do to a watch is to drop it.

Habitually subjecting a watch to jolts and jars is another cause of injury. In wrist watches the casualties are especially high. Many young women who have brought me expensive wrist watches that weren't keeping time have been astonished when I have guessed their occupation as stenographers. My guess always has been based on the assumption that their watches had been thrown out of adjustment as a result of constant violent vibration, as the fingers of their owners have pounded a typewriter keyboard.

DAMPNESS rusts the delicate parts of a watch movement. Don't lay your watch down or hang it up near an open window—especially at night.

Guard your watch against dampness when you are at the seashore. And remove your wrist watch when bathing.

Dust, dirt, and sand can wreak destruction if they get into the movement of the watch. Never open the back of the case outdoors, or where the air is dusty.

If you break the crystal, or even crack it, have it replaced immediately, for the dust that reaches the dial through the crack may find its way into the movement.

Always keep your watch pocket free from dust and lint.

If your watch is gaining or losing, make it keep time. You can do this just as well as a watchmaker, but of course you should use extreme care. In the back of the watch is a pointer, which must be moved toward "F" (Fast) if the watch is losing, and toward "S" (Slow) if the watch is gaining. Touch this pointer gently and move it as short a distance as you possibly can. After the regulator has been moved, wait several days before making further change. Then move it again. Repeat this process until your watch is running on the second.

REGULARITY in winding your watch is essential if it is to keep correct time. A watch should be wound every 24 hours, and at the same time each day.

You should have your watch cleaned and oiled at least once a year. Remember that it ticks 157,000,000 times in 12 months, and that with every movement there is a friction strain on some part which can be relieved only by lubrication.

The modern watch is in reality a box of wonders. It is the one marvel of science that every man uses.

Your watch, in short, is your most important possession, your most faithful friend. Consider its marvels, and you will never again treat it casually.

$25.00 in PRIZES See top of page 6 in front of book for details

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This square does the work of Trysquare, Mitre, Octagon, Bevel and Protractor equally well. Pressure on a button in the head of the handle releases the blade and you can change from one angle position to another instantly.

Accurate always — fits the hand—the ideal tool.

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AIR-FRICTION CARBURETOR CO.
868 Raymond Bldg. Dayton, Ohio, U. S. A.

Here Are Correct Answers to Questions on Page 71

1. The coldness and dryness of the air cools the skin. This increases the circulation of blood. The better circulation carries more oxygen to the brain and other organs and makes us feel more active.

2. In samples of rock that explorers have brought back from the polar regions, geologists have found fossils of plants that grow only in warm countries.

3. The air contains a small amount of sulphur gases, derived, usually, from the sulphur contained as an impurity in coal and other fuels. Silver takes up the sulphur gases and forms a black compound called "sulphid of silver."

4. Yes. The waves that are shorter than about 70,000 to the inch cannot be seen by our eyes, though they are otherwise just the same as light. These are called the "rays of ultraviolet light."

5. Among other changes the heart beats faster and the sizes of the different blood vessels are altered. The arteries leading to the digestive organs become smaller, while those leading to the heart, the lungs, the brain, and the other nerve centers become larger. Thus the blood is taken away from the organs that are not going to need it so urgently and is sent where it is needed more. It becomes well charged with oxygen, which will be needed in the muscles in case you have to fight or to run away, and plenty of the well-oxygenated blood is sent to the brain to aid in controlling these muscles.

6. The layer of air next the ground gets heated, usually because the sun overheats the ground and this heats the air next to it. This hot layer of air bends back the rays of light just as though it were a mirror. So it reflects the light of the sky just as a water surface would.

7. It is called the "pineal gland." It has somewhat the same nerve connections and structure as an eye and it corresponds to an organ found in many fossil lizards, which may have been an actual eye on top of the head.

8. White *reflects* the heat rays from the sun. Black *absorbs* them.

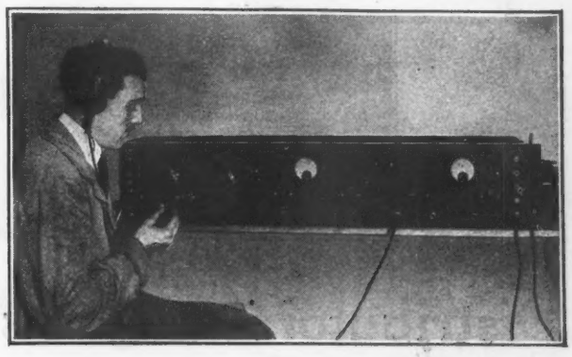
9. Weight is merely the attraction of gravity and it exists between any two pieces of matter. So scientists first determine the amount of the attraction between a small piece of matter, say a tiny ball of pith, and a huge mass of lead. Then they determine the attraction of the earth for the small ball of pith. This will be a great many times as much as the attraction of the mass of lead for the pith ball. The earth is just that many times heavier than the mass of lead.

10. It is a toxin produced by the germ that causes botulism, a form of food poisoning.

11. It is a difference in how far the atoms or molecules inside the substance are away from each other. If they are very close together, the substance is solid. If they are a little farther apart, so that they can move around freely, the substance is a liquid. If they are so far apart that they have no attraction for each other at all, then the substance is a gas.

12. No. Whenever these are studied scientifically, it is found that "hunches" or reasonless predictions are no more accurate than mere baseless guesses are. There is no evidence that man is able to foresee the future in any way except in so far as he can do so by his reason.

For expensive, delicate parts—what panel will you use?



THE picture shows the front of a Super Heterodyne hook-up. This set has a normal range of 3,000 miles. When a radio fan builds this set he must use the best radio parts he can buy. And he needs a panel that will help those parts operate most efficiently.

A weak battery, a burned-out tube—any defective part—merely reduces the range of a set instantly. A cheap radio panel can hinder the effectiveness of the best instruments made.

Radio fans all over the country construct their sets around Celoron Standard Radio Panels. One of them, Mr. Phil Davies, of Grand Rapids, Michigan, writes about his Celoron panel:

"I bought a Celoron Panel, first, because of the low loss of high frequency currents and its high dielectric capacity; second, because of its strength and durability; third, because of its beautiful finish; fourth, because of its convenient size."

Radio set manufacturers who use Celoron panels in their cabinets help fans get greater volume and clearer reception. Manufacturers of radio parts who mount their instruments on Celoron bases give insulation those parts need. In Celoron they have a bakelite product that is one of the best insulating materials known. Its dieletric strength has been proved time and again. The U. S. Signal Corps and U. S. Navy approve it heartily.

Celoron Radio Panels were the first to be cut in standard sizes and wrapped in individual packages. They come in the following standard sizes, finished in black, mahogany or oak:

1— 6 x 7 x 3/16
2— 7 x 9 x 3/16
3— 7 x 12 x 3/16
4— 7 x 14 x 1/4
5— 7 x 18 x 1/4
6— 7 x 21 x 1/4
7— 7 x 24 x 1/4
8—12 x 18 x 1/4
9— 7 x 26 x 1/4

Special sizes cut to order from sheet stock.

Radio manufacturers can buy Celoron in sheets, tubes, rods, and special forms. Leading radio part makers have already found that Celoron is an ideal material to use for cabinets, switch bases, and other radio and wireless equipment.

Radio fans who buy completed sets containing Celoron Standard Radio Panels and instruments insulated with Celoron can be sure of getting the insulation their sets need. Write to us for complete information regarding the use of Celoron in the manufacture of sets and individual radio parts.

Write for our free booklet, "Getting the Right Hook-up with Celoron." It contains diagrams, list of broadcasting stations, and valuable radio information for the set-builder.

To Radio dealers: Send for special dealer price list showing standard assortments.

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Gen. Elec. 1725 speed	$14.75
Gen. Elec. 1-2 H. P. Rep. Ind.	39.00
Master 3-4 H. P. Rep. Ind.	52.50
Master 1 H. P. Rep. Ind.	60.00

Special values in rebuilt motors
HYRE ELECTRIC CO.
625-H S. Dearborn St., Chicago, Ill.

Agents $72 a Week

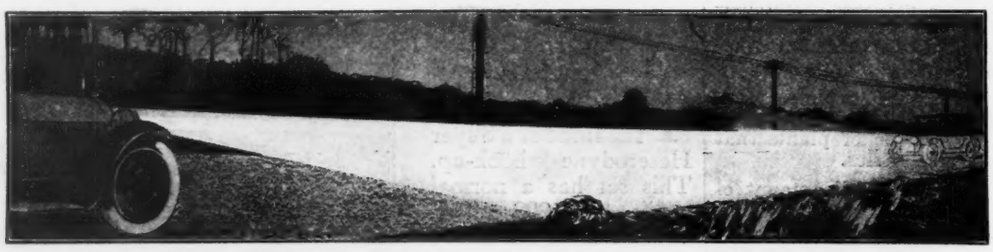
Take orders for the Serenola. Something new. Wonderful invention. The Serenola does more than machines costing 10 times its price. Big demand. Easily carried with you anywhere. Built in—just like a suitcase. Fully guaranteed. Low price. Must satisfy customers or money back.

Easy To Take Orders

Biggest, best and most profitable proposition we have ever offered. Big money on every order. No Capital needed. No collecting. Pay you every day. Rapid promotion from Agent to District Manager. Grats of Ky. left a $30 a week job and is now making over $100 a week right along. Ted Gnau averaged $87 a day for four months. Arthur Yost averaged $600 a month. We have hundreds of agents making from $7 to $21 a day. Over 10,000 instruments already sold. Don't pass up this wonderful opportunity. Write or wire us for territory.

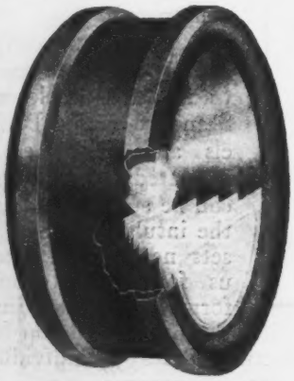
PERRY-LUDLOW CO., S-3547, Dayton, Ohio

A Perfect Glareless Headlight At Last



Distributors—Agents and Dealers—Can Make $3,000 to $15,000 or More a Year

The Detroit Safety Headlight Devices absolutely solve the greatest menace to automobiling—the headlight glare. This is a new, simple device and fits any model of any car. Installed easily and quickly by anyone. Used with low priced plain glass lens. It adds style and dignity to any car. It absolutely concentrates the light down on the road, not up in others' eyes. Drive with all the courtesy of the road with bright lights on. The glare is positively eliminated. Will last a lifetime. Will not rust, corrode or deteriorate. Meets every legal requirement. They are the best headlight devices made and stand any test.



PATENTED

Detroit Safety Headlight Devices Sell On Sight

They sell on sight—a demonstration sells anyone. Easily demonstrated in store, home or on car. Sold on 30 day trial—never taken out. Appeals to fairness—no one wants to drive others to death in ditch. Owners urge others to buy. See illustrations as to installation and effect.

Exclusive Territory—Newspaper Advertising—Installed Free

Exclusive territory granted to right men—we run newspaper advertising and arrange for **Free** installation by competent garages. Printed matter and cards also furnished. We want men in every county who can handle men and sales and make from $3,000 to $15,000 or more according to territory.

FREE—One Set. Free Introductory Advertising Offer

FREE—One Set Free Coupon

Motor City Syndicate
Offices: 4490 Cass Ave., Dept. 43
Detroit, Mich.

Gentlemen: Without obligations, please send literature of Detroit Safety Headlight Devices. Send such offer as I have marked below.

Do you want to sell?.....

What territory?.....

Make of your car.....Model.....Year....

Make of other car.....Model.....Year....

Fill in both for $2.00 offer.
Just use Dollar Bills if sending money.
Enclosed $..... for offer as marked above. These to be mailed postage paid.

Name.....

Address.....

City..... State.....

One set of Detroit Safety Headlight Devices in a neighborhood makes everyone want them. It's the best kind of advertising for our representatives. Therefore, for a short time we will sell two sets for the price of one ($2.00) or one set at wholesale price of $1.00, postage paid. Buy two sets, sell one easily at $2.00—yours will be free. This offer is open to everyone to advertise the devices. When territory Representatives are appointed offer ceases—so act now. Easily installed by anyone. Get literature—clip FREE coupon, fill in, pin $1 or $2 bills to coupon—act quickly NOW.

Motor City Syndicate

Offices: 4490 Cass Ave., Dept. 43

Detroit, Mich., U. S. A.

ART COLOR PRINTING CO., NEW YORK